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Secretary Taft on the Panama Canal.

It is doubtless known to many engineers that there will be a determined attack on the administration of Panama Canal affairs in the next session of Congress. There are some members of that body who have never acquiesced in the decision in favor of the Panama route but cling to the Nicaragua route with an affection that will heed no criticism. There are others who see no advantage whatever in a canal that warrants the expenditure of millions to attain it. There are others who fear that there have been extravagance and poor judgment in the management of the work, and there are many who believe that the situation affords a fine chance to worry the administration and to indulge in the irresponsible criticism that is part of the game of politics. There has been a great deal of untrue and misleading comment on the Isthmian Canal Commission, along with some that was undoubtedly warranted, but the latter was on details of minor importance compared with the broad administrative policy which will shortly be attacked at Washington. This policy has been creditable to the nation and to President Roosevelt, and it is well worth while to consider it at this time, particularly as Secretary Taft has seen fit publicly to reply to critics of it in his noteworthy speech before the St. Louis Commercial Club.

In the spring of 1902 Congress passed the Spooner act requiring the President to proceed with the construction of the canal, although it did not specifically state what kind of a canal should be built. It provided for the issue of $135,000,000 of bonds, and the further expenditure of $40,000,000 for the concession and property of the Panama Canal Co., $10,000,000 for right of way, and $10,000,000 for preliminary work preparatory to construction. The second Walker Commission had estimated that a lock canal would cost $145,000,000, and this estimate was the basis of the figures in the Spooner act. Congress recognized that the people of the country had entire confidence in the political integrity and business shrewdness of the President, and accordingly put the whole responsibilty of the undertaking on his shoulders. The only restriction on his powers was a requirement that the work must be immediately in charge of a commission of seven members, appointed by him, a majority of them to be engineers or army and navy officers with engineering experience.

In order that he might keep fully in touch with the work, this commission was ordered to report to the Secretary of War. It is difficult to estimate men of to-day in their true relations with great affairs, yet it is safe to say that in Judge Taft the country has an administrative officer of extraordinary ability and a temperament in perfect tune with the grave responsibilties he carries. His work was to be merely supervisory, or, to quote from his speech, "it was not expected that the Secretary of War would meddle or interfere with the sound discretion and generally free hand which must be vested in those specially appointed to build the canal if successful results are to be accomplished by them, but it was expected that the Secretary of War should have a general knowledge of the work, should be consulted on matters of general policy, and, when particular matters were called to his attention seeming to need further investigation, should make it and report the matter to the President." As a matter of fact, this close relation between the Commission and the Secretary could not be obtained, the President was not in touch with the work in the sense Congress intended, and he had to change the personnel of the Commission in order to carry out the spirit of the law. This journal firmly believes that the organization thus displaced accomplished much more than the President and the Secretary of War have appreciated, but it also believes that the old Commission did not report as fully as it should to those who were legally responsible for its acts. In other words, there was no administrative harmony, and the President's change in the Commission was intended to secure it, and has had that result.

While information was being secured on which to base definite working plans, a great deal of preparatory work had to be done. The construction of the canal will depend on the capacity of the Panama R. R. to a considerable extent. This had a fine roadbed but little else. It was 5-ft. gauge, making it tedious to secure new rolling stock, and its terminals were wholly inadequate; it has accordingly been put under reconstruction so that it can handle in addition to its regular traffic the supplies and construction trains that will run over it. Water works have been constructed. Shipping facilities at the terminals are being improved. Barracks for unmarried employes and quarters for the families of the married men are being erected. The sanitation of the Canal Zone is proceeding rapidly and satisfactorily, and the government of the Zone is working so smoothly that nobobdy hears of Governor Magoon and the admirable work he is doing. These and other features of this great undertaking have been described at length in this journal before, so there is no reason for entering into details of them now. Doubtless in the early days, before the administrative machinery was adjusted to its work, there were delays and unnecessary expenditures. These must accompany the inception of every great enterprise, however, particularly when the working plans for the undertaking are not settled and all the data on which to base those plans are not collected. But it it safe to say that the mistakes and needless expenditures on the Panama Canal are fewer than usual in work carried on under such disadvantages of location, climate and original local facilities.

A great deal has lately been said about the finances of the Commission. It had $10,000,000 for its preliminary work. It has spent $511,000 for general administrative expenses in the United States, $67,000 for administration expenses on the Isthmus, $143,000 for the general account of the Department of Government and Sanitation, $348,000 for the general account of the Department of Construction and Engineering, $1,383,000 for hospitals, sanitation, water-works, sewers, police and prisons, $155,000 for stock of the Panama R. R. Co. not held by the Panama Canal Co., $3,946,000 for permanent plant, $1,870,000 for other supplies, and $1,360,000 for canal construction. This makes a total of $9,783,000. The expense for labor and salaries amounts to about $600,000 a month, and consequently there is not enough money on hand to meet the December pay roll.

This fact is what makes the situation serious. It was supposed that an extra session of Congress would be called in October, when ample time would have been given for deliberation in making all the necessary appropriation. This was not done, and not only are there unpaid bills for supplies and materials which should be settled at once, but there are thousands of laborers and staff employes who will not be paid unless Congress passes an emergency appropriation as soon as it meets. This should certainly be done for the good name and sound credit of the country. The work has been pushed rapidly, its administration has been in the hands of the best men obtainable, and in order that its general plan shall be as sound as engineering skill can make it, an international advisory board of eminent specialists has been studying the work for many weeks. Nothing has been done that will be unnecessary if Congress determines to build a lock canal or a sea-level canal. Good value has been obtained for all money spent. Good men have been engaged, and that their salaries are higher than those paid in the department offices in Washington is due to the fact that these men are not in permanent places, which they will hold until their active life is over, but are engaged for only eight or nine years at the utmost. Under such circumstances the best men cannot possibly be engaged at the regular departmental salaries, and the fact that the sums are not too high is shown by the very small number of men in departmental service in Washington who have evinced the slightest desire for positions under the Isthmian Canal Commission.

If Congress desires to investigate the details of the administrative expenses on the canal work it has full power to do so. In fact, the investigation will be a satisfactory indication to the people that their money is being guarded and will be a good thing on that account. But the investigation should be conducted in such a way that the work now in progress is not stopped and there is no delay in meeting the payrolls. That would be almost disastrous and would have many serious results.

Engineering Precedents.

The practice of the profession of law consists largely in conforming to a systematic mass of court decisions carefully recorded so as to show the special conditions and general legal principles affected. The citation of the decisions of cases in the courts of last resort similar to or identical with any case in question is considered conclusive as to the results of litigation. These general features of the practice of law hold in spite of the fact that occasionally a court of last resort may reverse a preceding decision, nor are they inconsistent with the fact that new decisions may be expected at any time. The practice of civil engineering, on the other hand, is in some respects directly opposite in its features to that of law. Some of the most accomplished practitioners in engineering at times pride themselves upon having violated precedent by the adoption of new methods or new materials or in some other essential way in the successful prosecution of their work. It is not possible that there should be courts either of the first instance or of last resort in the practice of engineering. The works to be accomplished are based on methods and materials subject to constant development and occasional radical change.

There are many circumstances under which the engineer may fortify himself by the example of works already accomplished under conditions more or less similar to those constituting the environment of a new work to be undertaken; or proposed methods or materials may receive professional disapproval for the reason that similar results have not previously been accomplished. It is within the experience of every engineer of extended practice, however, to have observed that such conservatism not infrequently results in either unnecessary cost or diminished degree of excellence. In fact an engineer possessing an aggressive professional temperament and fertility of resources must frequently strike a judicious balance between novel procedures and engineering precedent. While he must have due respect for that which has been accomplished he must at the same time be resolutely pushing ahead of precedent to establish new high water marks of attainment in engineering work.

These general propositions will scarcely be controverted by any professional engineer, but there may be a justifiable difference of opinion as to the extent to which any engineer is justified in being governed by them under given conditions. In projecting any great work it is always necessary to make a decision between the use of grades of material hitherto used for the same purpose and improvements in them more or less radical, and it is occasionally essential to make a similar choice in methods of procedure. The conservative mind seeks the assurance to be derived from following those things which have already been successfully done, while the alert and more vigorously progressive individual endeavors to establish new grades of excellence and new methods of attaining them. There are engineers of repute and of long experience who decline even at the present day to use masonry instead of more expensive ashlar where the majority of engineers would not hesitate to use unlimited masses of the more economical material. Again, it was but a short time ago that a distinguished engineer in American practice opposed the use of concrete in a great work, where it was subsequently most successfully employed, on the alleged ground that it could not be given an enduring surface. Similarly, it was only two or three years ago that the use of nickel-steel in the eye-bars of a proposed great bridge structure was opposed in emphatic terms by many engineers on the ground that that material had not yet been sufficiently tried to give a proper degree of assurance as to its adaptability to the structure in question.

It is beyond all question that the judgment of the engineer must be his guide as to the adoption of new materials and procedures in violation of precedent, but there are certain general principles involved which should be respected and do not trench upon the proper use of precedent nor stand in the way of progress. It is obvious that experimenting by a young engineer, for instance, whose judgment has not been trained by experience is likely to bring financial loss to his client and prejudice to his professional standing. The young practitioner may, to a greater extent than the older member of the profession, follow somewhat along the lines of his legal friend. Accomplished work may suitably be a guide. In fact experimenting in practical work, except when directed in general by engineers of educational training and experience, is apt to be hazardous. On the other hand that kind of violation of precedent which follows from rational professional development, to the extent of displacing familiar methods or materials, is not only justifiable but highly desirable. It is only through such rational and well directed development, based sometimes largely upon full-scale experimenting, that the best and most healthful engineering advances are made. Any engineer who declines to use such a well tried material as concrete and involves his client in large additional and unnecessary expense in consequence of simple professional inertia is falling far short of serving his client with the efficiency and excellence that ought to characterize a high grade of engineering work. A well balanced construction, whether of a structure or machine, based upon the ground principles of engineering science and adapted to the actual conditions of practice need not be characterized by any degree of imitation of what has been done before. It may be new in every feature and yet be as fully justified as if the same thing had been done a hundred times before, provided the design and execution are based upon the broad general principles of similar practice. These general principles are not always easy to discover, but the degree to which they govern the advances in great engineering works is a measure of the professional capacity of the engineer who designs and executes them, irrespective of precedent or the dictum of pure authority. It must not be forgotten that in engineering as in no other profession "the standard of to-day was the novelty of yesterday."

Sewer Contractors as Engineers.

A small borough in Pennsylvania is now advertising for bids on a separate system of sewers and a sewage disposal plant, the bidders being required to visit the borough and to submit general plans with their bids. It has been some time since such an instance of combined engineering and contracting has arisen in sewerage works in the Eastern states, although ten or fifteen years ago the method was occasionally tried, to the deep regret of those involved in the undertakings. The Engineering Record does not know of a single case where engineering work of this nature has been left to contractors with any good results. Responsible contractors have enough to look after in the execution of their legitimate work to keep their hands completely full of detail. The design of municipal works has become a specialty, and the men who are giving their time to it are professional men, obliged to keep in touch with progress in many fields of applied science, just as the lawyer must always read law and the physician must always follow the voluminous literature of the medical profession. It is the engineer's province to tell his clients what they should do, but his responsibilities cease there unless he is retained to see that his advice is followed. The contractor's responsibilities are entirely different. He has to direct the men engaged on construction, to supply the plant necessary for their use and to furnish the materials for construction which are not supplied to him by the owner. In order to be successful he generally puts the work under competent foremen, trained by long experience with his methods, the more expensive parts of his plant are transferred from other works he is carrying on, and the whole undertaking is organized along lines he has found to be successful in such work. This is the practical, executive side of the undertaking, just as responsible and important as the professional part attended to by the engineer but wholly different in character. By adopting this system of divided responsibility the city is able to get the best work at the lowest cost, there is a minimum duplication of work in letting the contract, and both the city and the contractor have in the engineer a fair and impartial judge of the obligations of the two parties to the contract.

The other method, which the Pennsylvania borough has adopted, is full of openings for trouble and great expense, although it would be foolish to claim that such results would inevitably follow when it is employed. That they are likely to occur is evident from the following facts, however, which deserve consideration when the system is proposed. In the design of sewerage works it is necessary to make a study of the future requirements of the place and of the different ways in which it is possible to dispose of the sewage. Such investigations are engineering tasks, and must be conducted by engineers. If a contractor is to submit plans with his bid he must employ an engineer to study the situation; at least, he must do this if he is a reputable contractor. As a result the ground will be gone over by as many engineers as there are bidders, and unless these engineers are men of high professional standing and experience, such as are not likely to be engaged for the purpose, there will be a wide variation in the plans submitted. The borough has not gained anything by this, for the cost of the engineering will be entered on the contractor's charges and he will get a percentage on this cost as his profit for looking after the work. When the plans are presented to the borough it will have to pass on them. In order to ascertain which is the best; provided any of them are worthy of study, it will have to conduct an investigation of its own just as thorough as if it were to prepare plans and specifications. If this investigation is not made it will not be able to judge intelligently the relative merits of the plans offered with the bids, and its decision might just as well be made by spinning a teetotum as by making long-winded arguments on the subject. In other words it must employ an engineer any way. After a plan is adopted, it must employ inspectors working under the direction of an engineer in order to be sure that the contractor carries out the terms of his offer faithfully. In short, unless the borough authorities are willing to take anything that the most plausible talker offers, their engineering expenses will be greater than those incurred in following the usual procedure.

In making these comments on the position in which this borough is placing itself, this journal has no desire to criticise the good intentions of the authorities. It often happens that men of high standing are placed in charge of works with which they are not familiar, and naturally take them up in the same way that they take up similar new work in their own business. A man whose experience has been gained in many lines of manufacturing would naturally follow just such a plan as that outlined, unless he was warned in time that it was not suitable for the case in hand. It certainly is not suitable for sewerage and sewage disposal works, and it is to be hoped that the plan will be abandoned by the Pennsylvania borough while there remains an opportunity to do so.

Notes and Comments.

MUNICIPAL TRADING on a tremendous scale is proposed by the London County Council, which will endeavor to secure from Parliament permission to establish works for supplying electricity for power and lighting throughout the entire area of its jurisdiction. The county has recently taken over the property of the water companies, it owns a network of street railways, and if it obtains permission to take over the electric business of the metropolis there will be only the gas plants left for it to absorb. This municipal monopoly is so vast and concentrates in the hands of a few councilmen the power over such enormous investments, that it is not surprising even the British love of municipal trading seems staggered by the prospect. It is now proved beyond question that municipal ownership of public utilities may be a curse or a blessing, according to the class of men elected to office, and the class elected to the London County Council is not such as to inspire complete confidence in the success of a great municipal electric scheme.

THE USEFULNESS OF STEEL PILING in making repairs to dams is well shown by the methods adopted to raise a structure at Newaygo, Mich., which develops at present a head of about 22 ft. This is an earth dam, and it will be raised so as to give a working head of about 32 ft. In order to have the structure safe under this additional pressure, piles furnished by the United States Steel Piling Co. are being driven on the upstream side to act as a core for the enlarged structure. The piles are 18 and 20 ft. long and are driven into hardpan. Clay is being filled in over the piling and in front of it so that an impervious and stable structure will be secured. The work is being executed under the direction of Mr. W. J. Bell, general superintendent of the Newaygo Portland Cement Co., who states that the use of the steel piling has made it unnecessary to draw the water out of the pond, build coffer dams, excavate to hardpan and put in a concrete core wall, all of which would have been done had steel piling not been available.

A NEW MILLS HOTEL is to be erected in New York which offers some interesting suggestions concerning the itemized cost of apartment houses and hotels. This will be the third hotel built by Mr. D. O. Mills for the use of men of very limited means. The houses are commonly regarded as semi-charitable institutions, but as a matter of fact they are run so as to afford a moderate return on the investment and consequently their cost is governed by a very careful regard for business considerations. The new hotel will be a fifteen-story 100x175-ft. structure, entirely fireproof and built so that it can be kept clean at a minimum expense. It will be a close neighbor of several expensive hotels, and will have an attractive exterior so as not to affect property values in the vicinity, but the regular schedule of prices of the present Mills hotels, 15 cents for dinner, 25 cents for a bedroom and other things in proportion, will be charged. The architects are Messrs. Copeland & Doyle, and the consulting engineer is Mr. J. M. Robinson. The structure they will erect will be a most interesting study for those who wish to know what eight years of careful investigation and practical experience have taught Mr. Mills and his advisers to be the most economical construction and equipment for such buildings. The information is particularly worth study because Mr. Mills has never hesitated to spend money freely at the outset in order to secure economy in maintenance and repairs, and this new building will not be cheap in any sense except that its guests will be charged very moderate prices.

THE PRESIDENTIAL ADDRESS before a scientific or technical society comes in for a few words of pained criticism in a recent issue of "Engineering," based on an address recently delivered before the Institution of Civil Engineers by Sir Alexander Binnie. He began with the foundation of the Royal Society in 1660 and ended with some discursive remarks dating somewhere between 1760 and the dim future, bearing on the necessity of a unity of purpose among engineers. Although Americans as well as Englishmen are ready to give honor to this eminent engineer's achievements in municipal engineering, there is nothing in the address bearing on the specialty in which he is an acknowledged master, but there is a surfeit of platitudes that a school boy could dig out of a few reference books in any good library. The professional public will doubtless be rejoiced that this influential British journal has taken up the fight for a reform in this subject in the institution which represents the leading elements in the English-speaking engineering world. A man is elected to the highest office in one of the national societies, because he has accomplished so much that he is an ornament to the profession. His address as president of the society is one of the few things that cannot be discussed in the meetings of the organization, according to all rules and precedents. This is the finest opportunity he will ever have to deliver uncriticised his opinions on the specialty with which he is most familiar, and to establish precedents for others who are interested in it, but have not given it so much attention as he has. His presidential address really ought to be on his specialty, for it was because of it that he has been given the highest honor his associates can offer to one of the profession. If he chose for his theme some other subject he must have a better ground for it than could possibly be advanced for the historical and biographical meanderings in the recent address before the Institution of Civil Engineers.

A CORE WALL CONTROVERSY has arisen at Danbury, Conn., where a reservoir is now under construction. This will be formed by an earth dam, which was designed without any core wall. A protest against this plan was made, and the city has accordingly called into consultation Mr. W. S. Morton, engineer of several hydraulic power developments in the State, who has pronounced in favor of the plans as drawn. At the site of the structure there is no rock for a foundation, and Mr. Morton is of the opinion that a masonry core would be useless under the conditions, although he is careful to urge the importance of providing a spillway for the reservoir of such dimensions that the dam will never be overtopped. Without a complete knowledge of the conditions it is useless to discuss this particular case, but it should be pointed out in a general way that the omission of a masonry core wall lays the structure open to two chances of disaster that are not of much importance when there is a well-built wall. The first of these is the danger of percolation and washout through holes burrowed by animals. Accidents of this nature have occurred often enough to render them deserving of careful attention. The second danger is the certainty of destruction in case the dam is overtopped. Instances are on record where earth dams were overtopped but remained without serious injury on account of the resistance of the top of the core wall to erosion by the overflowing waters. It is possible to guard against this danger by constructing ample spillways, except where the flood of water is due to the failure of a reservoir higher upstream. In the latter case, an earth dam without a substantial core wall is practically certain to be breached and even the core wall may not prevent disaster. It should also be borne in mind that a masonry core wall resting on substantial hardpan is almost as effective as one carried down to bedrock, and if hardpan is present for this purpose it may be considered the equivalent of rock. If the core wall is omitted it will be necessary to use far more care in the selection and manipulation of the materials of the dam, its cross-section must usually be increased by making the slopes flatter, and the expense of the masonry may be equalled or even exceeded by the additional expense for earthwork involved in these ways.

EDITORIAL SUPERVISION of the reports of the bureau chiefs of the Navy Department will hereafter be exercised by Secretary Bonaparte before these documents are given to the public. It is understood that the new order to this effect is due to the remarks and recommendations on the subject of naval personnel made by Rear-Admiral Rae, engineer in chief of the Department, in his latest annual report. The Secretary has naturally been shocked at the state of inefficiency revealed by this report, just as he was shocked by the revelations of incompetency which the Bennington disaster disclosed. Like many other eminent men in public life, he believes that his surprise has been shared by those whose business it is to keep in touch with naval affairs. He probably believes that foreign governments learned for the first time from Admiral Rae's report that our costly vessels are sent to sea with their engines and boilers in charge of men who would not be trusted to run anything but the smallest stationary plants, were they engaged in private work on shore. In this he is entirely mistaken. The American navy enjoys the reputation of having good vessels, good sailors and brave officers, but no organization of the latter that deserves anything except condemnation. Every foreign naval officer knows perfectly well that there is not an American war vessel in commission to-day which has an engineer force as competent as that of even second-rate transatlantic liners, and knows that this condition is due to the jealousy with which the navigating and fighting officers regard the engineer officers, who are always the pick of the graduates of Annapolis. It is truly difficult to understand how any young man can look forward with anything but deep distrust to life as a naval engineer officer until this feeling of corps jealousy is obliterated. It is not at all unlikely that Secretary Bonaparte's order is an admirable one, for the annual reports of bureau chiefs are not intended for controversial statements concerning the fundamental organization of the navy personnel, but in so far as the statements in Rear-Admiral Rae's report are concerned there is nothing in them that has not long been known and recognized. The situation is an intolerable one, and the Secretary who can solve it will be a public benefactor; moreover, the naval officers themselves, outside of a few of the old ones, will be heartily glad to be free from the bickering that interferes with a rational discharge of duties.

Narrow-Gauge Locomotive Used in Distributing Cast-Iron Pipe.

THE PANAMA WATER AND SEWERAGE WORKS.

The City of Panama has a population of approximately 20,000. Estimates as to its future population, after the completion of the canal, vary greatly, and will depend, of course, upon the manner in which some of the problems connected with the construction of the canal are worked out. The buildings in the city are about equally divided in number between wood and stone or brick or concrete. Some of the latter are quite substantial, but the majority of the wooden structures are of the flimsiest possible construction. With the exception of an ice and electric light plant, and a repair shop for the Panama R. R. there are no manufacturing establishments.

Up to the time of the treaty with the United States there was absolutely no public water supply. All water was obtained from wells and rain water tanks. One of the best business enterprises in the city was the peddling of water from house to house, the ordinary charge being 1 cent gold per gallon. In the dry season water was very scarce, and prices rose accordingly. The Panama R. R., for its own use, had a well organized tank car system for bringing in water from some of the mountain streams.

Panama City had a number of drains for carrying off surface water and house sewage. Some of these dated from Spanish times and were well constructed, brick, concrete and rubble being used. They were all rectangular in section, and a few were as large as 4x6 ft. According to tradition, the largest of these was originally built to afford an exit from the cathedral to the shore in case of revolution or war.

Under the terms of the canal treaty between the United States and Panama, the canal commission was authorized as a sanitary measure to construct water works and sewers in the cities of Panama and Colon. The cost of construction and operation was to be covered by water and sewer rates so fixed as to cause the amortization of principal and interest in fifty years. At the end of this period the works were to become the property of Panama. One of the first steps taken by the canal commission after its organization was to provide for this water works and sewer construction, and work upon the water supply for Panama was begun in August, 1904. In general, it is a gravity system, consisting of a storage reservoir; a supply pipe line; a distribution reservoir, and a distribution pipe system.

The source of supply for Panama is the Rio Grande River, on which a storage reservoir has been constructed adjacent to the line of the Panama R. R., and about ten miles from the city. The drainage area tributary to this reservoir is about 5 square miles. It is practically uninhabited, and the land is largely owned by the canal commission.

The average rainfall on this watershed is about 90 in. per year. The area lies on the summit of the divide between the Atlantic and Pacific at an average elevation of about 400 ft. During the dry season of 1905, when there was practically no rainfall for more than four months, the minimum stream flow entering the reservoir was 400,000 gal. per 24 hours. The hillsides are clay and rock, but the dense tropical vegetation aids in producing a sustained dry weather yield.

At the point selected for the storage reservoir a small stone dam had already been built across a narrow rock gorge by the French about 1889. This dam was curved in section with a radius of 80 ft. It was 30 ft. high and had a top width of 4 ft.; the face down stream battered 1 in 5, while the water face was vertical. The height of this dam was increased 25 ft. by a concrete masonry wall 4 ft. wide. The ends of this concrete dam tied into solid rock, and the whole structure was reinforced by a substantial concrete gate chamber placed in the center of the downstream face. The downstream toe of the old dam was also reinforced by a concrete footing.

High water level in the reservoir is at ele. 240 above mean water at Panama. The waste way at present is over the top of the dam which has a length of about 130 ft. If the gorge of the Rio Grande River below the dam is filled with waste from the Culebra cut, another spillway will be provided. The storage capacity of the reservoir is 400,000,000 gal. The area flowed was cleared of all vegetable matter, and stumps and roots were grubbed out. No soil was removed.

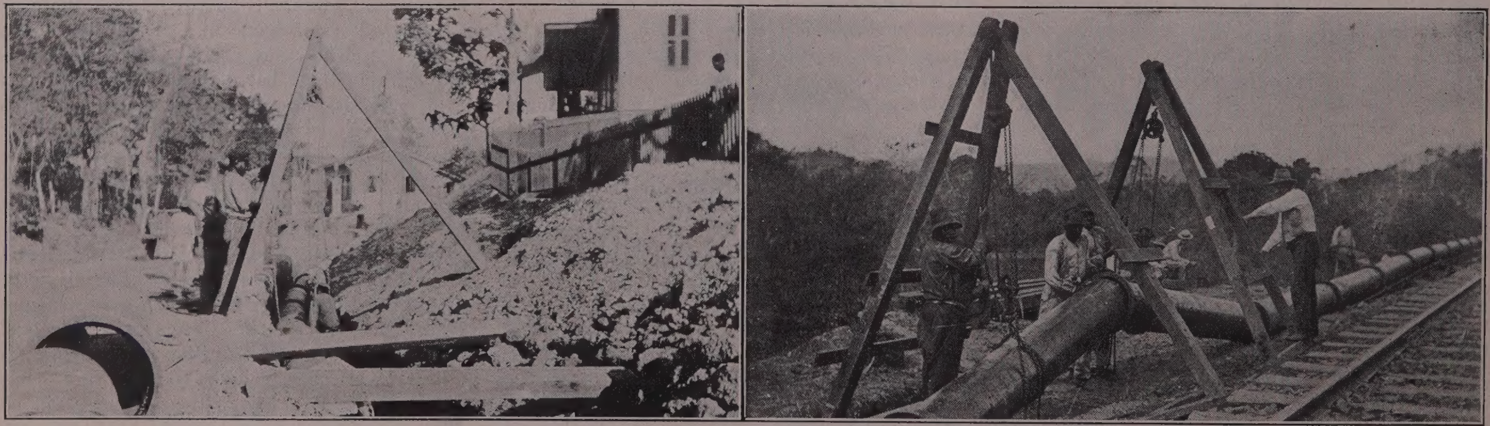
The work was done by men employed by the canal commission. The laborers were principally Jamaica negroes. The cost of concrete in the dam, including all incidentals, such as hospital expenses, paymaster's expenses, etc., was $10.50 gold per cubic yard. The unit prices for material delivered at the site of the work were as follows: Cement, $2.21 per bbl.; sand, $1.25 per cu. yd.; crushed tone, $2.04 per cu. yd.; lumber, $20 per M. Ft. B. M. Atlas cement was used. The cost of clearing and grubbing the area flowed was $207.30 per acre.

Coffin sluice gates were used in the gate chamber. The screens were made in the shops of the commission, and consisted of angle irons and perforated metal.

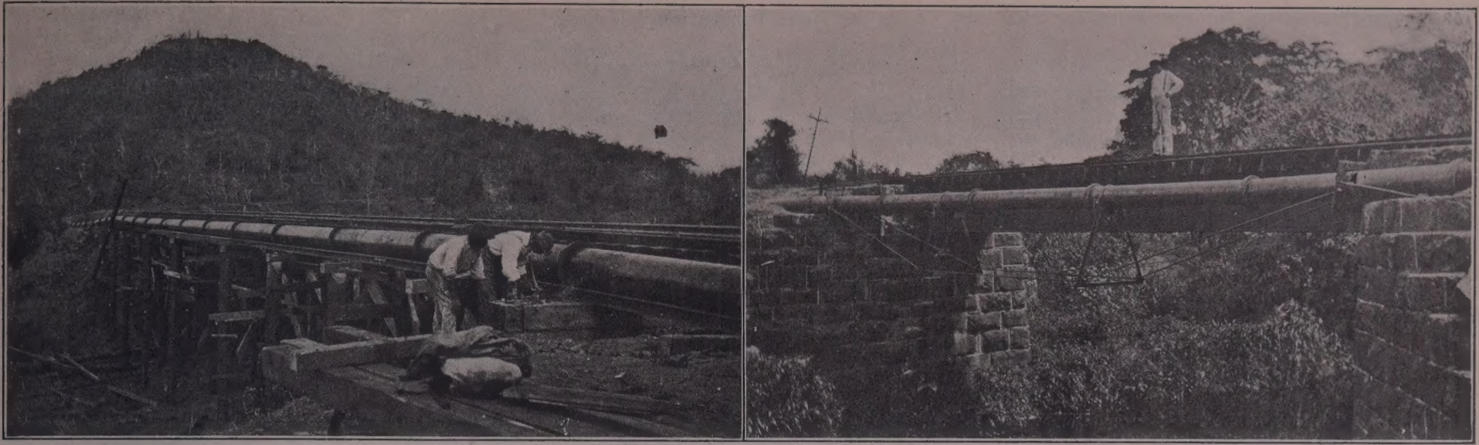
The pipe line from Rio Grande reservoir to Panama is laid in the gorge of the Rio Grande River for 4,000 ft. At this point it meets the Panama R. R., and thence to the Ancon distribution reservoir near the city it is laid alongside the tracks.

The upper 4,000 ft. in the gorge of the Rio Grande River consists of 20-in. flanged, galvanized, riveted, wrought iron pipe, 1/8-in. thick. This pipe was laid by the French about 1889 to carry water to the Culebra cut. It was in such excellent condition that it was taken up and relaid as a part of the permanent Panama line. As it is possible that this galvanized pipe may be covered by waste from the Culebra cut it was surrounded by 6 in. of concrete. The cost of taking up and relaying this 20-in. galvanized pipe was $1.24 per lineal foot. The cost of the concrete surrounding the pipe was $20 per cubic yard, the unit prices of material being the same as above for the Rio Grande dam.

From the end of this galvanized pipe to the Ancon distribution reservoir the line consists of 16-in. cast iron pipe, furnished by the United States Cast Iron Pipe and Foundry Co. from their plant at Anniston, Ala. The cost per lineal foot was as follows: Excavation, 19 cents per lin. ft.; pipe and pipe laying, $1.86 per lin. ft.; caulking,



Pipe Laying near Ancon Hospital and along Railway on Line From Rio Grande Reservoir to Ancon.



Panama Aqueduct Crossing over Canal Location and over River.

36c. pr. lin. ft.; backfilling, 18c. per lin. ft.; total, $2.59. Pipe delivered on the ground alongside the railroad cost $1.60 per foot, lead 5 cents per lb.; the pipe weighed 125 lb. per foot.

The Ancon distribution reservoir is located on the grounds of Ancon Hospital, about one mile from the center of the city of Panama, and at an elevation of 137 ft. above mean tide. It is a concrete basin with a capacity of 1,000,000 gal. Owing to lack of water in the dry season of 1905 concrete work on this reservoir was stopped, and the reservoir was not completed at the formal turning on of water on July 4, 1905. A by-pass is laid around the basin.

From the Ancon reservoir to the city the distribution pipe line consists of 20, 16, 12, 10, 8 and 6-in. pipe, furnished by the United States Cast Iron Pipe and Foundry Co. All valves and hydrants were furnished by the Herron Pump & Valve Co. of Chattanooga, Tenn.

Water was formally turned on in Panama on July 4, 1905, at which time about 30 per cent. of the distribution system was complete. The entire system will require about 10 miles of mains, and to date about 6 miles have been laid.

Sewage from Panama will be discharged directly into Panama bay. The location of the city on a rocky peninsula, lying high, makes the disposal of sewage an easy matter. The city is divided into three drainage districts each with an independent outfall.

The combined system is used, designed to take care of all house sewage and storm water resulting from a rainfall at the rate of 1 in. an hour, except in the central portion of the city, where the sewers will carry off rainfall at the rate of 2 in. per hour. Any rainfall in excess of these rates will run off on the surface. There are no cellars to be flooded. Manholes are of concrete. The manhole heads and covers were cast in the Bas Matachin shops of the commission from iron left over from French days. No catch basins are provided, as these would serve as mosquito-breeding places.

The work of laying water pipe and sewer pipe in the city streets has proceeded simultaneously. As a rule manholes were built ahead, and with this method cross streets were not cut off from traffic. Trenches were shallow, though in a few cases it was necessary to go 15 ft. to obtain sewer grades. The water pipes were given a uniform cover of 2 ft.

As it is the intention to pave the streets of Panama at once, all house connections, both water and sewer, are being put in now, whether the property served is built upon or not. As a part of the sanitary regulations, water and sewer connections are made compulsory, an order to this effect being issued by the Panama government as well as by the U. S. sanitary officers.

All old drains found in the streets were dug up as the laying of the new progressed. All existing house drains were connected temporarily to the new sewers. These old house drains were invariably rectangular in section, and not less than 12 in. square, and were capital collectors of filth. They will be replaced by circular pipes.

The soil of Panama city is largely clay, indurated clay, and soft volcanic rock. In opening up trenches no precautions were taken to disinfect the soil, except when an old drain was encountered, in which occurrence chloride of lime would be used to counteract the odor. The health of the men engaged in the work was surprisingly good, and there was absolutely no sickness in the neighborhoods where work was going on that was unusual or could be in any way attributed to the overturning of the soil.

The Panama water works will furnish water for canal purposes as well as for the city. The supply pipe line leading to the city runs parallel to the canal for about 8 miles, and water will be drawn from it for locomotives, steam shovels and shops, as well as to supply the canal towns of Paraiso, Pedro Miguel, Miraflores, Coroyal, and La Boca. In order to adjust the matter of payment for the works all water used will be measured and for this purpose Venturi meters have been installed.

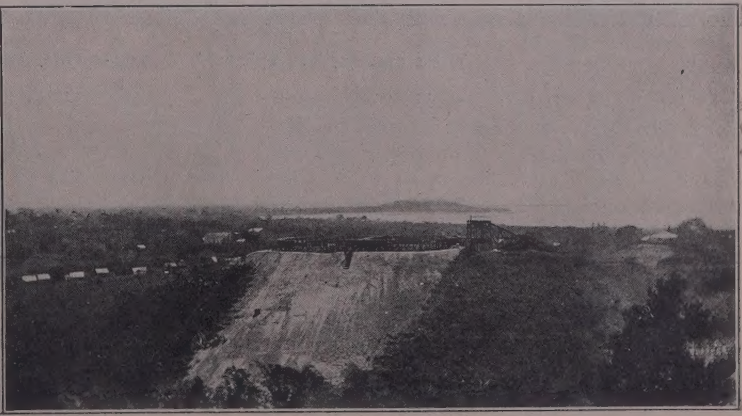
The quality of the water since it has been in use for the past four months has proven very satisfactory. In the rainy season the Rio Grande River, like all such streams, is heavily charged with clay, but the duration of storage is sufficient to allow for satisfactory sedimentation. There has been no trouble from algæ or other growth.

The Colon water works system is now being constructed and should be in operation in about six months. It will consist of a storage reservoir on a stream about 2½ miles east of Monkey Hill, a pumping station, force main, stand pipe, and distribution system. It will be operated for the benefit of the canal town of Cristobal, as well as for the Panama city of Colon.

No definite plans for sewers for Colon can be adopted until such time as a decision is reached in regard to filling in the city. At present a large part of the town is below high-water level.

In addition to the water works for Panama and Colon a large dam is being constructed on the Comacho River at Empire, which will furnish water by gravity for mechanical purposes for the adjacent sections of the canal, and for domestic and municipal purposes for the towns from Empire to Las Cascadas. Water works have been installed at Gorgona, for the town of Gorgona, and for the shops at Bas Matachin. These works require a pumping plant. Water works with pumping plant have been installed at Culebra for the town of that name. A special high service water works with pumping station is now being installed for the Ancon Hospital. The pumps for these latter plants were furnished by the Dean Co. of Holyoke. The

Typical Construction Gang, All Talking.



Ancon Reservoir, Panama in Background.

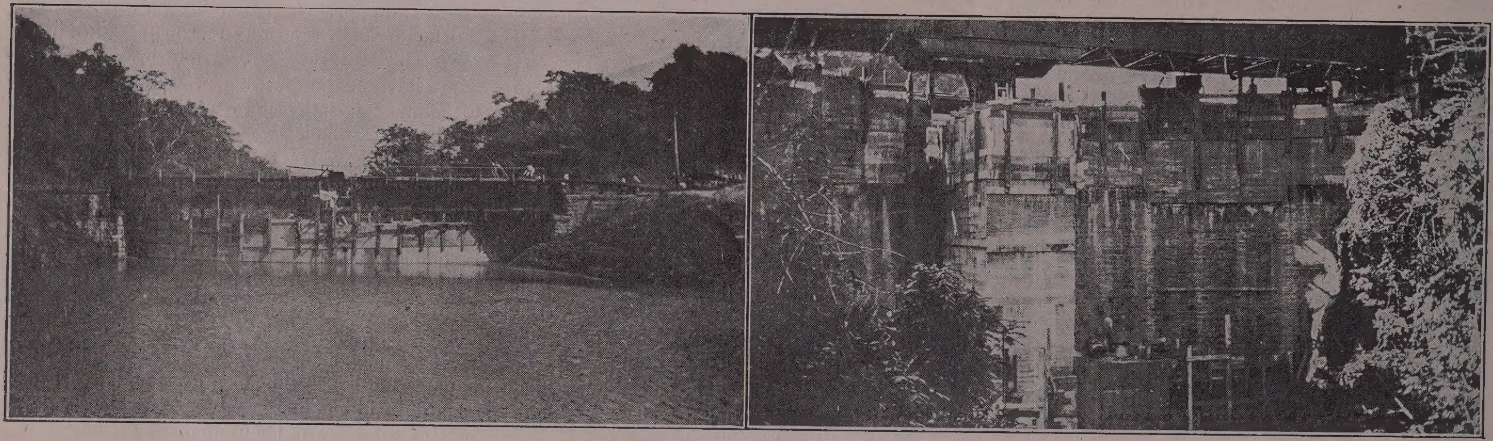
boilers were from Nagle Boiler Works of Erie, Pa.

Sewers have been installed and are in operation at Coroyal, Pedro Miguel, Culebra, Empire and Cristobal.

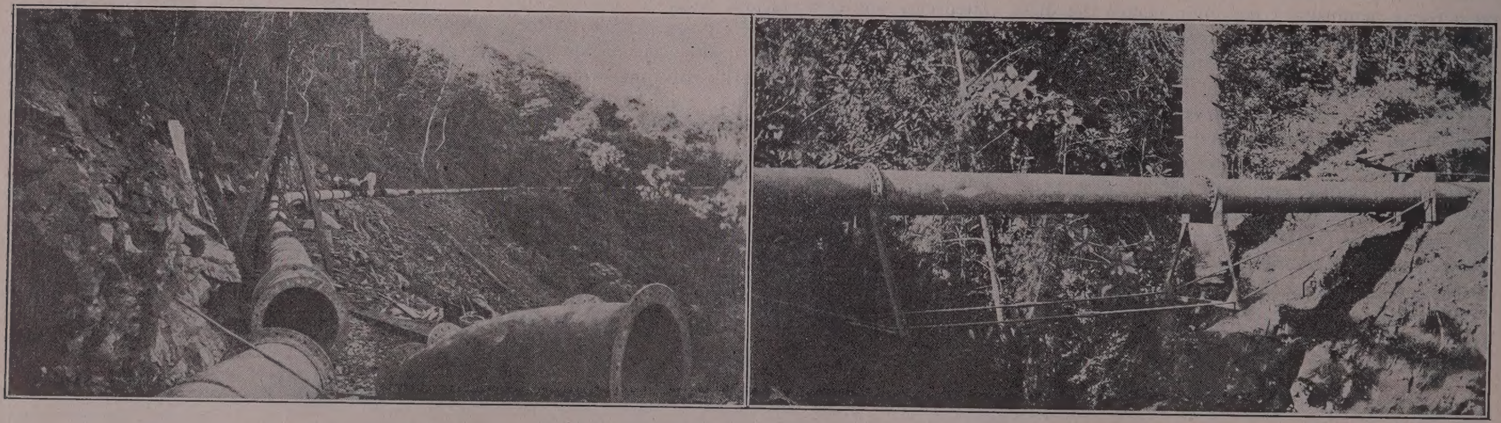
All these works were carried out under the direction of Mr. Carleton E. Davis, who was originally engaged as engineer of water works and sewers and later was appointed division engineer in charge of the Division of Municipal Engineering. Mr. E. W. Clarke was resident engineer at Colon, Mr. H. W. Durham at Panama and Mr. C. E. Marshall had charge of the Rio Grande supply. Since Mr. Davis's resignation to join the engineering staff of the Board of Water Supply of New York, Mr. Clarke has been appointed his successor as division engineer.

Railway Plant at Ancon Reservoir.

Panama Firemen Giving Exhibition.



Upstream and Downstream Views of Rio Grande Dam, Built under Railroad Bridge on which Materials were Delivered to a Hains Mixer.



Views on Aqueduct Laid with Twenty-Inch Galvanized Iron Pipe Left from French Administration.

A ROOT CUTTER has been brought out by the Harold L. Brown Co., of Boston, to cut out roots which grow into sewers, sometimes seriously reducing their capacity. It consists of a long strip of steel, sharpened on the edges and wound into a double-conical shape. When this is drawn through the sewer, the sharp steel edges shear off the roots.

Heat Insulation.

A paper read before the Faraday Society by Messrs. R. S. Hutton and J. R. Beard.

The importance of a knowledge of the heat conductivity of the materials used for the bricks or linings of furnaces scarcely needs to be emphasized. There is no doubt that a careful study of this subject would enable a very large saving to be effected in the fuel or other heating costs in many experimental and industrial furnaces. The manufacturer and purchaser of refractory products both seem to ignore the necessity for accurately determining the quality of their material so far as its heat-insulating power is concerned. Their specifications are confined to other properties, but it is doubtful if any of them are of greater economic importance than the heat conductivity. So far as laboratory crucible and muffle furnaces are concerned Mr. H. H. Cunynghame has recently shown how greatly the efficiency can be improved by the adoption of better insulation.

Despite the lack of knowledge, the measurement of thermal conductivities of such materials is by no means difficult to carry out—at any rate, to within an accuracy of 2 or 3 per cent. C. H. Lees and J. D. Chorlton have specially designed a simple apparatus for measuring the thermal insulation of bad conductors. We are indebted to Dr. Lees, who very kindly lent the apparatus, and also gave much valuable advice in carrying out the experiments.

Measurement of Thermal Conductivities of Granular Materials up to 100° Cent.—All the substances dealt with have been either in the state of well-defined granular powders; or in some few cases, where bricks have been examined, these were previously broken up and finely powdered. The apparatus of Lees and Chorlton was originally designed for round tiles or plates of material, but these have to be of uniform thickness, and 11.4 cm. diameter; and the shaping of bricks is not easily accomplished in the laboratory. A sketch of the apparatus is given in Fig. 1. It consists essentially of two thick metal discs, *A* and *S*, between which the material is placed, whose thermal conductivity has to be measured. The upper disc is surmounted with a steam jacket, while the lower one is allowed to cool by free conduction and radiation. Three thermometers are used; one, T_3, to give the temperature of the upper, the second, T_2, that of the lower disc, while the third, T_1, gives the temperature of the surrounding air. The thermometers are inserted into radial holes drilled in the discs, and thus denote their temperature with fair accuracy. When steam is passed through the steam jacket, the temperature of the upper disc is raised to nearly 100° Cent., heat flows through the material experimented on, and thus raises the temperature of the lower disc above that of the surrounding air. The lower disc loses heat by conduction and radiation to the air. Eventually a steady state is reached when this loss of heat is equal to the heat received through the material experimented on.

The following equation enables the thermal conductivity (K) to be calculated from the result of such an experiment, provided h_1, the external conductivity or "emissivity" has been previously determined:

$$K = \frac{t_2 - t_1}{t_3 - t_2}\, b \quad h_1 + h'_1 + \frac{p\ h_1}{2\ q}\, b \Bigg),$$

where t_1, t_2 and t_3 are the temperatures indicated by the thermometers T_1, T_2 and T_3 respectively, and b denotes the thickness of the layer of powder.

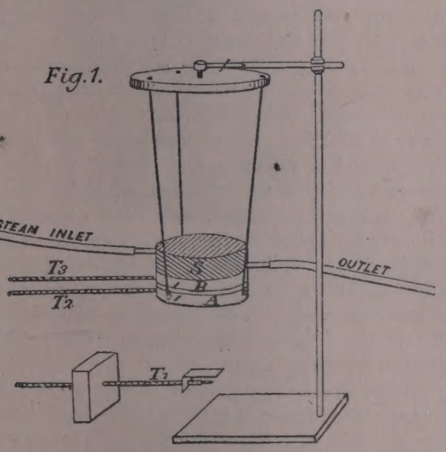
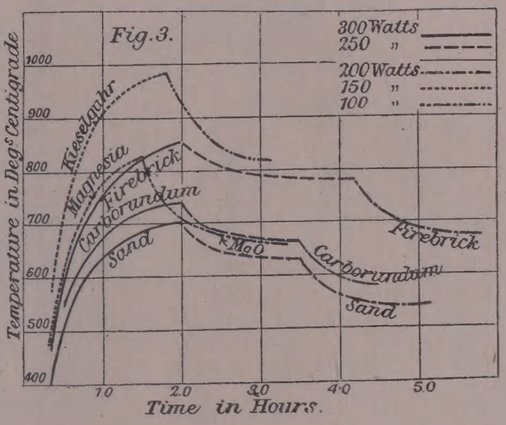


Fig. 1.



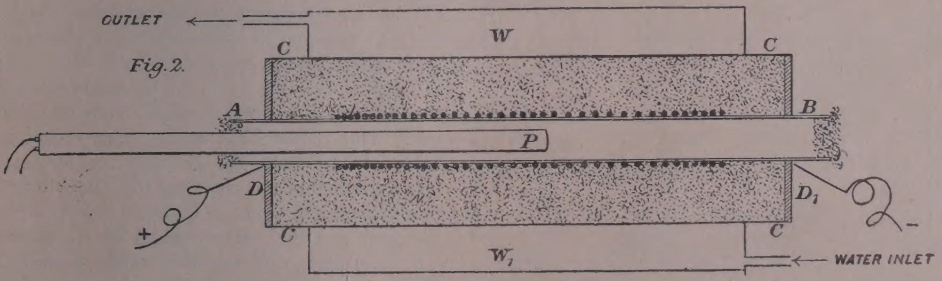


Fig. 2.

Diagrams Illustrating Apparatus and Results of Heat Insulation Experiments.

The value of h_1 is determined in a separate experiment from the rate of cooling of the lower disc at different temperatures.

In all the experiments here recorded the thickness was practically the same (0.360 cm.) and as in nearly all cases the thermal conductivities were much of the same order, the term in the bracket was very nearly constant and equal to 0.00045 in all cases, except with kieselguhr and light magnesia, where 0.00044 is the value adopted.

Relative Value of Different Heat-Insulating Materials at High Temperatures.—It is not advisable to choose a material suitable for furnace uses from the data in the table alone.

Firstly, it is always necessary to know the general effect upon the substance under investigation of such temperatures as are likely to be experienced. Several, even among those materials mentioned in the table, are unsuitable for subjecting to high temperature on account of the physical changes, such as shrinkage, which they undergo. Chemical action, especially oxidation, also renders many insulators unsuitable for a large number of purposes.

Secondly, having by such considerations excluded all unsuitable materials from the choice, it becomes necessary to compare the relative efficiency of those which remain under conditions more nearly approaching those experienced in practice.

The following experiments were carried out with a view to testing in as simple a manner as possible the behavior of various refractory materials at comparatively high temperatures. The method employed, although it does not directly lend itself to the accurate measurement of the absolute conductivities, at any rate offers a practical means for making comparative tests.

RESULTS OF TESTS OF CONDUCTIVITY.

Substance.*	Thickness. cm. —	Temperatures. t_3	t_2	t_1	Conductivity. K
Sand. White Calais	0.360	98.4	81.0	18.2	.00060
Carborundum (fine)	0.363	98.7	78.8	18.3	.00050
Carborundum (coarse)	0.358	98.7	79.6	18.7	.00051
Quartz, "enamel"	0.362	99.3	75.4	21.7	.00036
Quartz, fused	0.362	98.9	74.9	17.4	.00039
Firebrick†	0.363	98.7	69.2	20.3	.00028
Retort graphite	0.363	100.0	76.6	19.6	.00040
Lime	0.363	98.1	70.1	20.8	.00029
Magnesia-fused	0.356	98.7	78.6	20.0	.00047
Magnesia, "mabor" brick	0.360	99.7	80.0	18.8	.00050
Magnesia, calcined Greek	0.365	99.3	78.3	20.4	.00045
Magnesia, calcined "veitsch"	0.366	99.7	73.9	20.0	.00034
Magnesia, Pattinson's light calcined	0.363	98.0	58.5	19.7	.00016
Kieselguhr (infusorial earth)	0.366	97.9	53.9	17.7	.00013

* Most of these granular powders just passed through a sieve with 600 meshes per square centimeter.

† Different makes of firebrick will obviously vary greatly according to chemical composition and physical character.

Description of Apparatus.—A modified form of electrically-heated tube-furnace was employed. An unglazed porcelain tube, *A B*, with a heating coil of nickel wire is supported at the center of a cylindrical water-cooled enclosure, *C C C C*, the space between the heating coil and the inner wall of the enclosure being filled with the granular material under investigation (see Fig. 2). The porcelain tube is kept in position at the center of the sheet iron cylinder, *C C C C*, by washers of asbestos card, DD_1. WW_1 is the water jacket surrounding the cylinder *C C C C*. The electric energy expended in the wire is kept constant over a considerable period by careful adjustment of an external resistance and constant observation of a precision wattmeter. The temperature at the center of the porcelain tube is noted at regular intervals by the thermo-electric pyrometer, *P*, and from the observations a curve is plotted to show the relation between the rise of temperature and the time during which the heating has been in progress. The temperature of the water flowing through the external jacket was kept fairly constant; generally it varied some 2° Cent.

In such an experiment it would require a very long time for the temperature to attain a constant value. It was, therefore, found preferable, after the rate of increase in temperature had become rather slow, to reduce the power by a small but definite amount. Under these conditions the temperature falls, at first very rapidly, but soon reaches a constant value, or, at any rate, falls so slowly as to be almost negligible. It is from a comparison of the heating curves with different materials, and the same expenditure of power, and particularly from the nearly horizontal portion of the curves with lower expenditure, that valuable conclusions can be drawn. The diagram (Fig. 3) illustrates some of the results obtained.

In the case of firebrick, carborundum, and sand, the preliminary heating was effected with 300 watts, and after the lapse of about two hours the power was reduced to 250 watts, being kept constant at this for a period of 1½ to 2 hours, by which time the temperature had become almost constant. The curves for kieselguhr (infusorial earth) and light magnesia clearly show the very much smaller conductivity of these materials. With these two substances the preliminary heating was effected with an expenditure of only 150 watts; but despite this, the rise in temperature is more rapid than with any of the other materials mentioned.

Unfortunately, neither light magnesia nor infusorial earth can withstand any high temperatures for long without losing their efficiency to a considerable extent. Both substances exhibit large shrinkage at high temperature, and their chief uses are likely to be limited to external jacketing of furnaces lined with some more permanent but less good, insulator.

To more thoroughly test the above method of comparing the relative efficiency of different materials at high temperatures it was thought advisable to see what influence the preliminary heating might have on the results. Two similar experiments were therefore carried out with various substances. In the first case the preliminary stage of the heating was effected with 300 watts, and in the second with 250 watts. In both cases the power was subsequently reduced to 200 watts, and then to 150. The results showed that in all those cases in which no permanent alteration is brought about in the materials under test the horizontal portions of the curve are practically identical, whatever the preliminary treatment.

In earlier experiments, in which no water-cooling had been used to maintain constant the temperature of the outer jacket of the enclosure, some anomalous results were obtained.

General Conclusions.—The above results will, it is hoped, prove of value to those who have to deal with refractory materials. The subject seems to have been much neglected, considering that the thermal conductivity of such substances is the characteristic property which is really applied in their many uses. While bricks and generally jacketing materials for furnaces should be of low thermal conductivity, it is of no less importance to choose crucibles, retorts, and other containing vessels which are heated externally, of as high conductivity as is feasible in conjunction with their other necessary qualities. Such methods as have been described are equally applicable to this latter case. By a judicious use of the different materials and a stratified form of construction, it should be possible usefully to employ such excellent insulators as infusorial earth without risk of the damage which is inevitable if they be permanently subjected to too high a temperature.

The above experiments were carried out in the Physical Laboratories of Manchester University.

The East Canyon Creek Reservoir, Morgan Co., Utah.

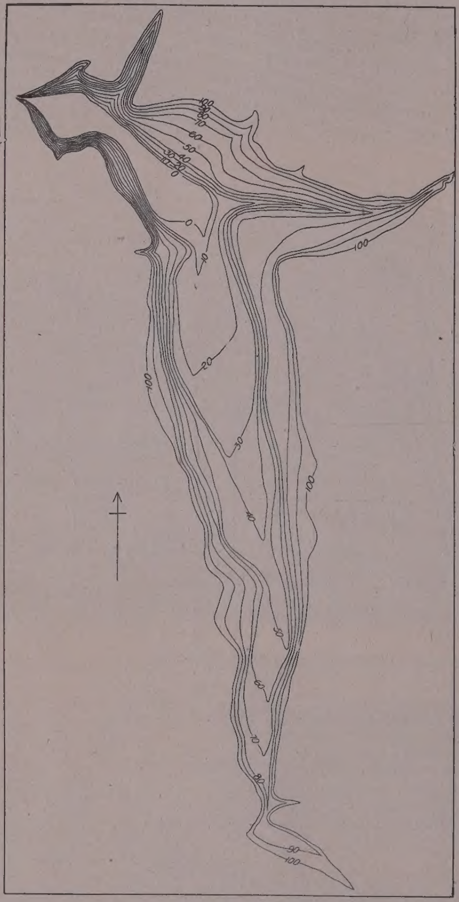
By Wm. M. Bostaph, C. E.

History of Enterprise.—A brief history of this enterprise may contain something of interest to engineers who are seeking to reclaim by irrigation portions of arid America. It may likewise serve to encourage communities of western farmers who are now suffering for lack of water to join hands in an effort to secure additional supplies by the construction of dams of a similar kind. The fertility of the soil, the crops raised, and the nature of the climate in the locality to be described are somewhat similar to those to be found in numerous other sections that might be transformed by an adequate supply of water from fields partially barren to those of high productivity.

The Davis & Weber Counties Canal Co. is composed of farmers in the country tributary to Ogden City, Utah, and at the time this enterprise was inaugurated, owned a canal of a capacity of 100 cu. ft. per second taken out of Weber River near the Devil's Gate in Weber Canyon, 10 miles southeast of Ogden. The canal extends along the hillside on the south side of the river for a distance of 9 miles to the top of the bench 5 miles south of Ogden. Here it is divided into three branches, north, west, and south. The north and west branches take about one-fourth of the supply, which is used to irrigate the lands lying west of Ogden, while the south branch, about 10 miles long, is used to irrigate the lands lying west of the canal and extending to the eastern shore of the Great Salt Lake.

The tract of land tributary to this canal comprises about 12,000 acres and extends from Ogden south to the town of Kaysville, a distance of 15 miles, along the lines of the Oregon Short Line and Rio Grande Western railroads. Notwithstanding the great fertility of the soil, the favorable climate and the nearness to markets, this large tract of land yielded meagre returns on account of the lack of water until after the completion of the reservoir. The Davis & Weber Counties Canal Co., being one of the late appropriators of the waters of Weber River, was entitled to a portion of the natural flow only when there was a surplus. Usually about July 1 of each year, when the discharge of the stream was needed by prior appropriators, this company was compelled to close its headgates and to keep them closed throughout the remainder of the irrigation period. Not being able to secure water for their crops after the spring floods had subsided, the farmers were compelled to resort to grain raising and one hay crop on both of which the profits were small. No vegetables, root crops, or fruit could be produced on account of having no irrigation water in July, August and September, but with water for the entire irrigating season three crops of alfalfa hay, all kinds of fruit and vegetables can be grown to perfection. The summer rainfall was insufficient to mature crops. For a period of 27 years the average rainfall at Ogden for the months named is as follows: June, 0.6 in.; July, 0.2 in.; August, 0.5 in.; September, 0.7 in.; total, 2.0 in.

To provide water for irrigation during the latter part of the season, the company resolved to build a reservoir in which to store the spring floods, which always provide abundant water from melting snows on the high mountains adjacent to this valley. A suitable site for a reservoir was found on East Canyon Creek, the largest tributary to Weber River, about 26 miles above the headgate of the canal and about 20 miles northeast from Salt Lake City in Morgan county, Utah. This creek rises in the mountains near Park City and flows in a northerly direction a distance of 25 miles to the junction with Weber River. It runs along the eastern base of the Wasatch Range, the Salt Lake Valley being across the range on its western side. Ten miles below the junction, the Weber River turns west and cuts through the Wasatch Range, running through a canyon and enters the Salt Lake Valley. East Canyon Creek has a drainage area of 300 square miles and a maximum flow of 1,200 second-feet. The mean flow in the months of February, March, April and May is about 300 cu. ft. per second; the minimum flow in the summer and fall is about 10 second-feet. At a point about 12 miles above the junction with Weber River the stream, after passing through a valley about 800 ft. wide, enters and flows through a canyon for 600 ft. The walls of this canyon are of conglomerate rock and nearly vertical. In the summer of 1894 the company engaged the services of Samuel Fortier, then professor of engineering in the Agricultural College at Logan, Utah, and the writer, as consulting and chief engineers respectively, who examined this canyon and selected the site for the dam at its upper end, made the necessary surveys and maps and filed an application for a right of way for a reservoir, which was approved early the next year, and in 1897 work on the dam commenced.



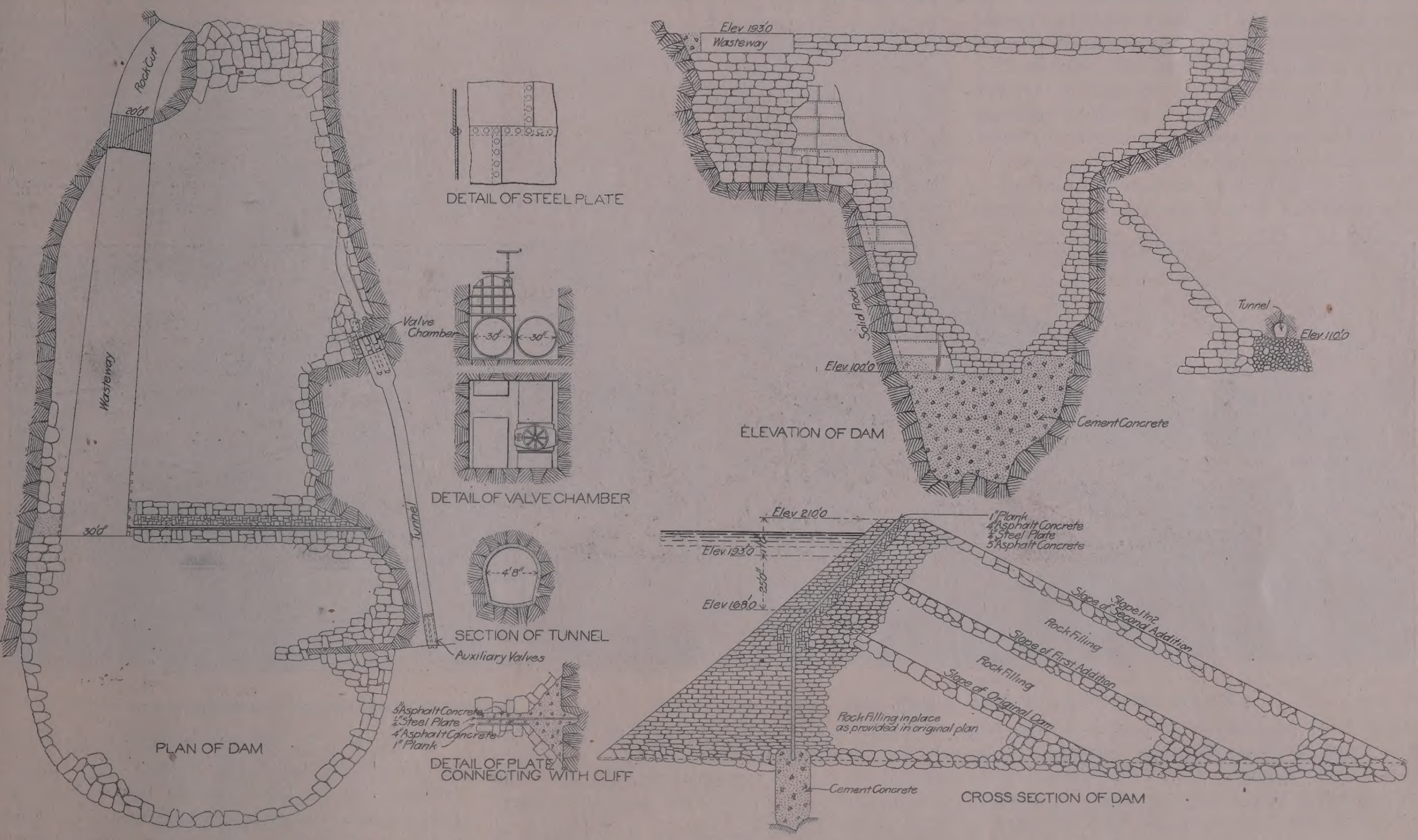
Contour Sketch of Reservoir.

Rock-Filled Dam.—A temporary dam was built about 1,000 ft. above the canyon. The natural flow of the creek was taken up, carried in canals and flumes, and discharged into the canyon below the dam site. An excavation was made 15 ft. wide extending across the canyon, which at this point is 54 ft. between side walls at the ground level, and solid bed rock without crack or seam was found at a depth of 35 ft. below the surface. The engineers decided on the type of dam known as "rock filled," with a center core wall of steel plate imbedded in asphaltum concrete. The first step toward construction was putting in a cement concrete foundation, which is also a cut-off wall. Bed rock was cleared of all loose material, and as it was polished by the action of water in past geologic times, the side walls and bottom were roughened by blasting out several hundred cavities, and filling the excavation with concrete composed 1 part of Portland cement, 2½ parts of clean, sharp sand, and 5 parts of washed gravel. Suitable sand and gravel were found in abundance within 2,000 ft. of the dam site. This part of the work was completed in March, 1898, and in August following a contract was let to build the dam. This, as originally built, was 68 ft. high above the original bed of the creek and 58 ft. above the bottom of the outlet tunnel. The steel plate center wall is composed of plates 5 x 20 ft. in size, riveted together with ⅝-in. rivets on 2½-in. pitch. There are three tiers of sheets, the bottom tier 20 ft. in height is ⅜ in. thick, the middle one 20 ft. in height 5/16 in. thick, the top one 28 ft. in height is ¼ in. thick. The whole is riveted and calked water-tight and covered with two coats of refined asphaltum. The foot of the bottom pier is riveted between two angle bars 3 x 4½ x 5/16-in. and rests on the concrete foundation. The steel core wall extends across the canyon and 1½ ft. into a trench blasted into the side walls. The steel center is imbedded between two walls of asphaltum concrete, each 4 in. thick. These walls are increased in thickness at the ends of the steel plate core wall to 4 ft. to make a more secure joint with the side walls of the canyon. This concrete is composed of 30 per cent. sand and 70 per cent. of gravel, mixed with refined asphaltum, allowing 9 lb. of asphaltum per cubic foot of mixed sand and gravel. The whole was mixed while heated to a temperature of 250° Fahr. and deposited and rammed into place while hot.

The bottom of the steel wall for a distance of 5 ft. up was imbedded in cement concrete, a dry rock wall was built up, the stones being carefully laid and bonded, with all the spaces filled with broken rock. Each wall is 20 ft. in thickness at the bottom and 10 ft. at the top. On the upstream side of the dam a face wall 5 ft. in thickness is laid on a slope of 1 to 1. On the downstream side the face wall is the same thickness and laid on a slope of 2 to 1. The portion of the dam between these walls and the walls next to the core is filled with rock dumped in, with all the spaces carefully filled. The rock for all this work was procured by blasting it from the sides of the cliffs on either side of the canyon. This fell in large masses, many containing from 500 to 1,000 cu. yd. each. The blasting was done before the core was built up. The rock that fell on and near the concrete foundation was removed and the latter cleaned of all materials. The steel plate wall was then set in position and the asphaltum concrete and the cement concrete around the bottom deposited and rammed. The walls were built of large stones hoisted into position with derricks.

Outlet Tunnel.—At a point 70 ft. to the right of the north end of the dam is the upper portal of the outlet tunnel. This was originally 190 ft. long and excavated through the solid rock side wall of the canyon. The discharge is below the downstream toe of the dam. The tunnel is oval in form, 6 ft. in height and 5 ft. 5 in. in width. At 130 ft. from the upper portal a shaft 8 ft. square extends from the cliff above, down to the floor of the tunnel. Two 30-in. valves are placed in this chamber, each connected to two 30-in. cast-iron plates, which extend into the tunnel each way. These are imbedded in a wall of cement concrete, which securely closes the tunnel against the passage of water except through the valves and pipes. Stems attached to the valves reach to an operating platform built on top of the valve chamber. Two auxiliary valves, in all respects like the main valves, are placed at the upper portal of the tunnel, attached to 30-in. steel pipes extending 12 ft. into the tunnel. These valves and pipes are imbedded in cement concrete. Stems reach from the valves to an operating platform attached to the side of the cliff above the surface of the reservoir. All the large valves have hand wheels at the tops of the stems. A 6-in. pipe is laid through the concrete at the upper portal, in which is a valve with a stem reaching to the platform of the auxiliary valves. This 6-in. pipe is used for refilling the tunnel and removing the pressure from the front of the auxiliary valves when repairs to the main valves become necessary. A 5-in. pipe fitted with valves connects the tunnel on the upper side of the valve chamber with the latter, extending up it to a point above the water level of the reservoir, serving for the escape of air when the tunnel is being refilled after making repairs.

Wasteway.—A wasteway 30 ft. wide and 6½ ft. deep is provided, being located on the south end of the dam. A flume constructed of lumber, resting on a shelf built into the side wall of the canyon, extends 190 ft. on a grade of 1 in 8 to a point beyond the toe of the dam, and discharges the surplus water over and against a rock cliff below the dam.



Diagrams Showing Construction of Rock-Fill Dam of East Canyon Creek Reservoir.

The dam and the rest of the work were completed April 1, 1899. In the construction there were used 23,000 cu. yd. of rock, 810 cu. yd. of cement concrete, 183 cu. yd. of asphaltum concrete, 69,800 lb. of steel, 50,500 ft. B. M. of lumber. The total cost was $50,200.

The area of the surface of the reservoir at 58 ft. above the bottom of the tunnel is 225.4 acres, and the capacity is 167,500,000 cu. ft., or 3,845 acre-feet, which cost $15.65 per acre-foot.

The water in the reservoir was rising rapidly at the time of the completion of the dam, and within two weeks thereafter was discharging through the wasteway. About six weeks after this the valves were closed and the leakage was measured. This was found to be 2.7 sec-ft., coming through innumerable small seams through the rock cliffs on each side of the dam. The company began drawing on the reservoir for its canal on July 5, 1899, using 50 sec.-ft. During the winter of 1899-1900 but little snow fell in the mountains, and all the streams the following spring became low. The company opened its reservoir gates on June 22 and supplied its customers with water for two months at a time when other canals were dry.

Raising Dam.—In the summer of 1900, the dam was examined with a view to raising it 25 ft. higher. It was found that the dry walls had settled about one foot, the steel plate was found in good condition. A contract was let for raising the dam to 83 ft. above the outlet tunnel. The plan followed lines similar to those of the original dam, except that the steel core wall was inclined downstream at an angle of 30 deg. from the vertical, which was necessary to connect properly with side walls of the canyon. The rock was removed from around the steel to a depth of 10 ft. and the new steel was riveted as in the original dam and covered with hot asphaltum. The walls on the downstream side were built up to the full height of 25 ft. and the steel core wall was anchored to them. The lateness of the season made it necessary to suspend work, close the valves and begin to store water before the upstream side of the steel plate was properly protected. The reservoir was used in 1900 and 1901 without any protection to the steel plate. The cost of this improvement was $35,500. The surface of the reservoir was increased to 262 acres, and the capacity to 387,500,000 cu. ft. or 8,895 acre-feet, and provided 70 second-feet of water for 60 days. In 1901 an estimate was made of the value of the crops produced with reservoir water, and the aggregate was found to be over $40,000 besides water for several hundred acres of young orchard not yet producing.

In the fall of 1902, the company decided to add another 17 ft. to the height of the dam and bring it up to the full 100 ft. above the outlet tunnel originally contemplated. An examination showed that part of the steel core wall that had been left unprotected was in such condition as to necessitate taking it down and rebuilding it, and before work was commenced, the steel fell, carrying part of the rear wall with it. The rivets were cut, the plates removed and rebuilt at an angle of 45 deg. with the vertical, downstream. On the downstream side of the steel core, a rough rubble masonry wall, laid in cement mortar 6 ft. in thickness, was built 5 in. from the steel core wall, and this space filled with hot asphaltum concrete mixed as in the original dam and tamped into place. On the upstream side a wall was laid up on a slope of 1¼ to 1, covering the steel core wall 10 ft. thick, and next to the steel plate a layer of 4 in. of asphaltum concrete was laid. This was covered with lumber 1 in. thick before the stone wall was built over it. At the ends of steel plate, trenches were cut into the rock and the asphaltum concrete widened out to 4 ft. on each side next to the side walls. The top width was made 15 ft. The downstream slope remained at 2 to 1. The form and location of the wasteway is the same as in the original dam, extended beyond the toe of the dam.

The main and auxiliary valves remain as originally placed and n careful inspection show neither injury or wear. Additional gearing and stems were added to bring the hand wheels above the top of the dam, and render them more easily operated. A lining of 4 in. of cement concrete was put into that part of the tunnel above the main valves, and the lower end extended by cutting under the cliffs and discharging the water beyond the toe of the dam.

The work was not completed till the spring of 1904. On May 13 the reservoir was full of water. There was found to be no perceptible increase in leakage through the dam, and every part proved to be in operation all that was anticipated.

Cost of Dam.—The entire cost of the dam and reservoir from the date of the first surveys in 1894 until the completion of the third addition to the structure in 1904 is given in the following table. The item for sundry expenses includes a large number of individual expenditures such as measuring weirs, building, repairs, etc., which have been grouped under this head:

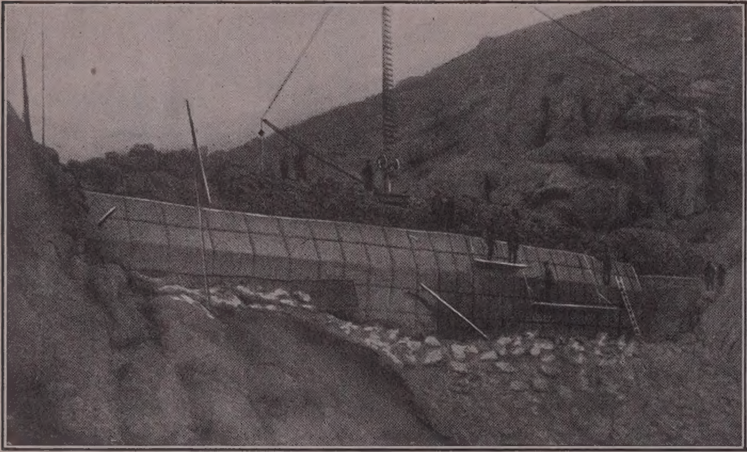
Excavation of foundation, 940 cu. yds., at $2.30	$2,162
Portland cement concrete, 1320 cu. yds. at $8.50	12,920
Asphaltum concrete, 660 cu. yds., at $10	6,600
Steel plate in place, 164,200 lbs., at 7 cents	11,494
Masonry laid in cement mortar, 2280 cu. yds., at $6	13,680
Excavation of tunnel and valve chamber, 520 cu. yds., at $8	4,160
Lumber, 120,000 ft., at $30 per M	3,600
Valves, stems, pipes and appurtenances	2,400
Rock derrick placed in wall, 28,000 cu. yds., at $1.24	34,720
Rock blasted down into dam, 68,500 cu. yds., at 25 cents per cu. yd	17,125
Lands purchased	1,000
Roads and bridges around reservoir	1,500
Sundry expenses	8,000
Engineering superintendence and incidental expenditures	8,000
Total	$127,361

The area of the reservoir at the 100-ft. level from the outlet tunnel and at the 145-ft. level from the bed rock is 280 acres, and its capacity 558,700,000 cu. ft., or 12,826 acre-feet. Comparing the total cost with the available capacity, the cost per acre-foot is $9.93. The term "available capacity" is here used because in operation it has been found that the computed capacity of the reservoir has been considerably increased by water stored in underground reservoirs, which as the reservoir is drawn down returns to the main reservoir and in this way not only compensates for the loss due to evaporation, but provides about 6 per cent. in addition.

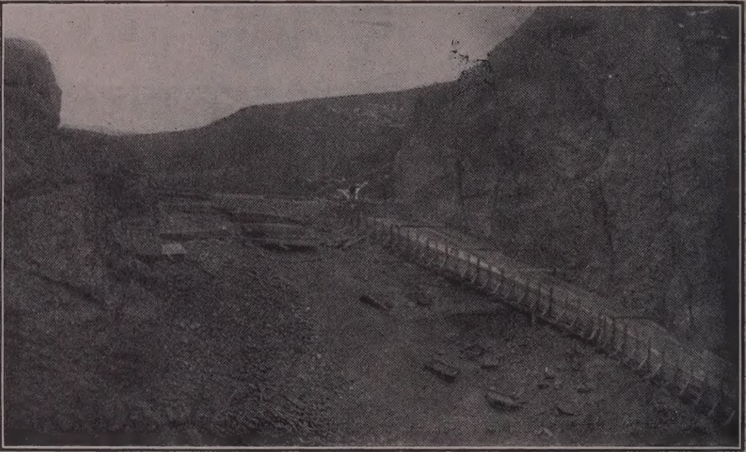
In the year 1904 a continuous stream of 115 second-feet was drawn from the reservoir for 62 days. This water flows through the channel of East Canyon Creek, mingling with the natural flow to the junction of Weber River, thence down Weber River to the company's head gate, where it is diverted into the canal, now enlarged to 200 second-feet capacity.

Financial.—From a financial point of view, the enterprise has been more successful than the most sanguine of its friends anticipated. A careful estimate of the crops produced by reservoir water in the year 1904, shows their value to be over $75,000, more than 58 per cent. of the cost of the entire works. Another index to the value of the property is found in the fact, that while at the time the enterprise was first commenced the Canal & Reservoir Co. had 4,000 shares of stock outstanding, par value $50 per share, which were selling on the market for $12.50 per share, and dull sale at that, now there are 6,000 shares outstanding, worth $90 a share, and very little can be purchased at that price. Besides this, the value of the land under this canal has increased on an average of 100 per cent. Many hundreds of acres of orchard have been planted that are beginning to bear fruit, all made possible by the construction of this reservoir, and a water right in this canal and reservoir is regarded as the best in this part of the state.

The whole engineering work, from the selection of the dam site in 1894 to the completion of the dam in 1904, has been under the direction of the writer as chief engineer, and Samuel Fortier, now irrigation engineer in charge Pacific District of the Irrigation and Drainage Investigations of the Office of Experiment Stations, U. S. Department of Agriculture, as the consulting engineer. The phenomenal success of the enterprise is largely due to the free hand which the company has always given its engineers to carry out the work on somewhat novel, but on what they regarded and what has proved to be, safe lines. All the work, except the surveys and work of putting in the foundation, has been done during the presidency of E. P. Ellison, of Layton, Utah.



Placing Steel Plates for Core of Dam.



Spillway for East Canyon Creek Reservoir.

The Problem of the Gas Turbine.

Address by Dugald Clerk on Assuming Office of President of the Junior Institution of Engineers.

The wonderful success obtained by your distinguished Past-President, the Hon. C. A. Parsons, and his many able followers with the steam-turbine in its various forms, has naturally attracted the attention of engineers to the apparently analogous problem of the internal combustion turbine. Accordingly, much mathematical and engineering ability has been recently devoted to the subject, so far, I am sorry to say, without concrete result. In this subject, as yet, the dreams of the theorist obstinately decline to realize themselves in tangible iron and steel.

I have not been able to find any gas-turbine in a state of effective rotation doing useful work, though I have noted many statements in the Press to the effect that some wonderful German, French, or Italian gas-turbine had worked, or was about to work in such manner as to relegate the ordinary cylinder and piston gas-engine to the museum with which many engineers used to threaten the steam-engine. One gas-turbine only has really rotated within my own direct knowledge. It was designed by Mr. F. W. Lanchester, of Birmingham, to operate with exhaust gases from one of the petrol engines used in his well-known motor-cars. He assured me a few days ago that it really rotated at a high speed, and made a loud shrieking noise, but only gave, he said, a total brake horse power equal to that capable of being evolved by two bluebottle flies. This power he did not consider satisfactory.

Speaking seriously, it does seem remarkable that so much interest should be taken by so many able men without any sort of result in practice. Why is this? I propose to-night to answer the question in so far as I can. It appears to me that most of those who have written on gas-turbines, and have even designed and patented them, have given too little weight to certain differences between the steam and internal combustion engine problem. Many, indeed, have assumed that the solution of the gas-turbine problem is the easier of the two, and that few difficulties exist which have not already been met and conquered by Mr. Parsons in the steam-turbine.

Many distinguished men have been of this opinion; and even Mr. Parsons himself, so early as his first turbine patent (No. 6735 of 1884) appears to have been of opinion that the hot gas or internal combustion turbine presented practically the same problem as the steam-turbine. In his specification, he made the following statement:—

> Motors according to my invention are applicable to a variety of purposes; and if such an apparatus be driven, it becomes a pump, and can be used for actuating a fluid column, or producing pressure in a fluid. Such a fluid-pressure producer can be combined with a multiple motor according to my invention; so that the necessary motive power to drive the motor for any required purpose may be obtained from fuel or combustible gases of any kind. For this purpose I employ the pressure producer to force air or combustible gases into a close furnace of any suitable kind, such as is used for caloric engines, into which furnace there may or may not be introduced other fuel (liquid or solid). From the furnace the products of combustion can be led, in a heated state, to the multiple motor, which they will actuate. Conveniently the pressure producer and multiple motor can be mounted on the same shaft, the former to be driven by the latter; but I do not confine myself to this arrangement of parts.

Clearly here Mr. Parsons intended to apply his invention to the gas-turbine as well as the steam-turbine; and in this paragraph he outlined the fundamental idea of nearly all subsequent proposals of gas-turbines. Many other inventors have followed him; but I may only mention two well-known names—those of Ferranti and Stodola. Both have proposed turbines similar to this, with more or less elaboration, as well as other modifications intended to overcome certain difficulties.

In a very able paper read before the Institution of Mechanical Engineers last year. Mr. R. M. Neilson discusses various cycles of operation which can conceivably be applied to gas-turbines, and he calculates the efficiencies of these cycles in various combinations. More recently, too, the subject has been exciting great interest in America, and very interesting articles are to be found in the "Engineering Magazine" by Dr. Charles E. Lucke and Professor Sidney A. Reeve. These gentlemen take somewhat opposing views of the position of the problem.

In most of the recent discussions upon gas-turbine problems, it has been recognized that the temperatures possible in the cylinder gas-engine are impossible for the gas-turbine. It has been fully proved by many investigators (including myself) that the temperature quite common in ordinary gas-engine practice ranges as high as 2000° C., though in the best practice, for most economical results, 1500° C. or 1600° C. appears to be an upper limit. With these temperatures, a first-class modern gas-engine of about 50-h.p. will give an indicated efficiency of 35 per cent. At the same time, the negative work of the cycle is so low that the mechanical efficiency of the engine may be as high as 86 per cent., or even more. If one realizes what the temperature of 2000° C. means, it becomes very evident that no turbine constructed either on the lines of Parsons or Laval could possibly be made to work with continuous supply of such gases; as 2000° C. is considerably above the melting-point of platinum. It is much higher than the temperature at which cast-iron flows from the crucible, or, indeed, the temperature of the interior of the blast-furnace. Any blades of iron, steel, or, in fact, of any other material, even fire-brick itself, becomes fluid or semi-fluid at the temperature. It is obviously hopeless, therefore, to attempt in the gas-turbine temperatures which are quite feasible in the cylinder-engine. This fact, as I have said, is generally recognized. It is accordingly said, by those who take a favorable view of the gas-turbine, that it is necessary to supply the turbine with gases at a much lower temperature. Mr. Neilson fixes the temperature of 700° C. as one which steel turbine blades would probably stand without too rapid deterioration. I fear that on this point I must differ from him, because, in my experience, oxidation of steel (and even iron) is a fairly rapid process at this temperature. Nothing new has been proposed as to the thermo-dynamic cycle of the gas-turbine; so that all reasoning upon efficiencies depends upon the deductions already made from internal combustion engine practice.

View of East Canyon Creek Dam during Construction.

Seeing the impossibility of constructing a turbine with materials to stand a high temperature, many have proposed to convert high temperature into kinetic energy, so that instead of having work stored up in the gas in the form of heat, the heat shall disappear, and the energy of the heat be transformed into motion of the gaseous particles at a high velocity. Such proposals, then, include the compressing of a gaseous mixture to (say) 50 lbs. or 60 lbs. above atmosphere; the igniting of that mixture within a combustion chamber at constant pressure; and the expansion of the mixture through an expanding jet of the Laval type so as to drop the temperature and obtain its equivalent in kinetic energy or velocity of the gaseous particles. The rapidly moving particles at the relatively low pressure and temperature are then allowed to impinge upon rapidly rotating blades of sickle configuration; and they are supposed to give up their energy of motion to the blades, and so expend work upon the turbine. This appears to be the most feasible of all the gas-turbine proposals, so I will proceed to examine it a little more minutely.

Success by this cycle of operations requires (1) A rotary or turbine compressor of high relative efficiency. (2) An expanding nozzle which shall insure that free expansion is quantitatively equivalent to adiabatic expansion behind a piston. (3) A rotating turbine of such construction as to secure a very high efficiency of transformation of kinetic energy of the moving gas into effective work available at the turbine shaft.

Assuming air to be the working fluid, and the specific heat to be constant through the temperature range, it is easy to calculate the efficiency of the Joule or Brayton cycle, that these operations in effect represent. It would be useless to attempt to work a turbine at a pressure so low as to be relatively inefficient compared with the gas-engine, so I have chosen a Joule cycle of (say) 48 per cent. ideal efficiency, which in a cylinder gas-engine would probably give in practice about 30 per cent. indicated efficiency. For this ideal efficiency the pressure of compression would require to be 141 lbs. per square inch absolute. To give power with a reasonably small pump, I shall assume a maximum temperature of 1700° C.—that is, assuming a perfect compressor and a perfect nozzle expander, the temperature would only fall from 1700° C. to 750° C. Plainly, this temperature would be too high for a Laval disc with blades. In order to get a reasonable temperature on expansion, it would be necessary to assume a maximum temperature in the combustion chamber no higher than 1000° C.; and this would bring down the temperature after complete expansion to about 500° C., which, no doubt, steel turbine blades can be expected to stand for some considerable time.

With these assumptions, however, the gas-turbine would not be very economical as compared with cylinder engines, even assuming all difficulties overcome. The theoretical and practical difficulties, however, are very serious indeed. To begin with the question of an efficient air-compressor. I am not aware of any turbine compressor capable of compressing up to 140 lbs. absolute from atmosphere with anything like 60 per cent. efficiency. Before success could be attained, this efficiency of compression (so far as diagram is concerned) should be at least 90 per cent. in order to allow for unavoidable mechanical and other losses in the subsequent processes. It has, it is true, been proposed to substitute cylinder compressors operated from the turbine, instead of turbine compressors; but this, it appears to me, would be equivalent to abandoning at once all the advantages of the turbine principle. If reciprocating cylinders are to be used for compressing, there is no objection to using them also for expanding. No gas-turbine with cylinder compressors could, in my view, succeed.

Assuming, however, even 90 per cent. efficiency from a turbine compressor, and assuming that we have a compressed gaseous mixture burning freely in the combustion chamber at the desired pressure and temperature, we have yet to face the problem of the expanding nozzle. It is always assumed that, with the use of an expanding nozzle, temperature drop can be as certainly attained as with an expanding piston in a cylinder. This, it seems to me, has been by no means proved. You will all recollect Dr. Joule's famous experiment with two vessels immersed in water and connected together by a pipe having a stop-cock upon it. Air was compressed into one of the vessels, the water round the vessels stirred, and equilibrium obtained, while the other vessel was rendered as vacuous as possible. The stop-cock between the two vessels was opened, and it was then found that, when the water was stirred again, no disturbance of the equilibrium ensued. This, of course, meant that though heat was lost in the one vessel—giving velocity to the gases—it was gained in the other by the impact of the gases against the walls.

Joule modified this experiment by placing the two air-vessels in separate water containers. He then found that the temperature of the one dropped, due to expansion, but the temperature of the other rose as much as the first dropped. Apply this experiment to reasoning on the behavior of the flame in an expanding nozzle. Assume the two vessels to be connected by a Laval nozzle, and assume that while in the nozzle the gases experienced the full temperature fall due to adiabatic expansion. Immediately, however, on contact with the walls of the second vessel, the velocity of the particles would be stopped, and the temperature would be restored to a point somewhat above the original temperature—that is, the mass of expanding flame in the pressure vessel would gain heat by the amount the first vessel lost. This is the result of the final process. It will be easily recognized that to obtain a sufficient temperature drop in an expanding nozzle, necessitates the practical absence of turbulent motion of every kind—that is, to expand adiabatically, the jet must be so constructed that there is an absolutely smooth flow from high pressure to low, and no impact or loss of velocity from any cause whatever. So far as I understand expanding jets, no adiabatic expansion so perfect as this has ever been obtained.

Assume, however, that the efficiency of expansion in such a jet is (say) 90° per cent. We now come to the question of the efficiency of conversion by the turbine blades. In many calculations from diagrams, it is assumed that the efficiency of conversion of motion into work is practically perfect. This, however, is by no means the case in present turbines. Even the steam-turbine, high as its efficiency is, compared with the reciprocating engine, has no very high efficiency of conversion in any of the forms of turbine that are at present on the market. That is, if we assume a mass of gas to exist in a compressed state in a reservoir, and we choose to expand this mass of gas in two ways—for the sake of comparison, (1) behind a piston, and (2) by means of a Laval jet and turbine—we shall find that the efficiency of conversion of the turbine, when once high velocity is attained, does not exceed 80 per cent. In this respect the efficiency of conversion of rotating turbine blades is inferior to that of a moving piston in a cylinder. The reason of this is obvious. It is impossible to so arrange the impact of a rapidly moving gas with a turbine blade or blades in such a manner as to entirely avoid any turbulent motion. The impact, for example, of swiftly moving gases on a fixed surface ultimately results entirely in turbulent motion, which restores to the gas or to the blade struck all the heat which has disappeared in temperature fall due to adiabatic expansion. What is true of a fixed blade is to some extent also true of the moving turbine blades. A certain proportion of the energy existing in the gas in the form of motion is inevitably lost whenever this gas comes into contact with any solid surfaces. So much is this the fact that, in designing steam-turbine blades for any type of turbine, the shape of the blades, the shape of the space between the blades—both moving and fixed blades, or fixed jet and moving blades—is of the first importance; and it has only been found by experiment that certain shapes of blades and passages have a much higher efficiency of conversion than other shapes. In this respect, too, the turbine principle is inferior to the cylinder and piston. In a cylinder, with gases expanding behind the piston, the efficiency of expansion may be considered to be 100 per cent., and even an efficiency of compression in many gas-engines is also the same order. I do not here refer, of course, to heat losses due to conduction, or anything of that kind, but to efficiency of adiabatic compression or expansion.

Although the efficiency of expansion is relatively low for gases in steam-turbines, yet the turbine offers a great advantage in total work obtained from steam. This is due to the fact that the turbine avoids initial condensation; and, further, it permits of the utilization of a very long range of expansion at the low-pressure end, which is not available in the case of steam-engines. By saving, therefore, in minimizing initial condensation, and in obtaining added work from pressures wasted in the ordinary steam-engine, the Parsons steam-turbine more than compensates for any inefficiency of expansion as compared with the cylinder engine. It is well known, however, in turbines of practically all constructions, including that of Mr. Parsons, that the efficiency of the steam-turbine at the high-pressure end is not so great as that at the low-pressure end. This is partly due to the difficulty of adjusting the velocity of blades to suit the necessarily varying velocities at different points of the flow of the steam. This, however, is a small difficulty with the steam-turbine, but a very considerable one with the gas-turbine. Compared with cylinder expansion, I cannot see how it is possible, with present knowledge, to obtain an efficiency of conversion in a gas-turbine greater than 80 per cent. This is partly due to the high velocity of the issuing hot gases.

To produce an efficient gas-turbine, therefore, on the favorite cycle so much discussed recently, it is necessary first to have, as I have said, a very efficient compressor, a very efficient expanding nozzle, and a very efficient conversion when the moving gases strike the turbine blades. Using the numbers I have suggested, of 90 per cent. efficiency of compression, 90 per cent. efficiency of nozzle expansion, and 80 per cent. efficiency of conversion in the turbine, we have with a cycle having negative work equal to 0.4, the following efficiencies: To get 0.4 of work in compression, we shall require 0.445 of work put into the compression. On expanding in the nozzle, we shall obtain 0.9 only of the total energy of the flame gases in the shape of kinetic energy; and of that 0.9, we shall only get 0.8 returned in the shape of available work by the turbine part. That is, we shall get a total work from the turbine of 0.72; and deducting the negative work, 0.72 — 0.445 = 0.275. That is, from a cycle which should give us 0.6 in work, we shall only get 0.275, or about 22 per cent.

The practical efficiency of an engine of this kind will only be 22 per cent., even assuming the high efficiencies of compression and jet expansion which I have mentioned. In my view, no such efficiencies of compression or jet expansion are at present known; and accordingly there appears no likelihood of the production of any gas-turbine which can rival the reciprocating gas-engine in efficiency and in economy. To produce such a turbine requires the solution of three problems: (1) An efficient turbine compressor, comparable in efficiency with cylinder compression. (2) An efficient nozzle expander with a higher efficiency than 90 per cent. (3) An efficiency of conversion of kinetic energy of the moving gases into work delivered at the turbine spindle of greater than 80 per cent. Either these problems must be satisfactorily solved, or else new materials discovered which will stand temperatures which at present melt fire-brick. The outlook, I fear, is not hopeful.

This thermal efficiency of 22 per cent. assumes no losses in the combustion chamber due to heat conduction, no losses in the expanding jet due to heat conduction, and no losses in the turbine itself from the same cause. Considering the losses in gas-engine cylinders of small size, it would not be too much to allow in a turbine a heat-flow loss of at least 25 per cent. This, of course, reduces the efficiency from 22 per cent. to 16.5 per cent. In arriving at this figure, I have assumed that no greater loss would be incurred from heat-flow in the turbine than in the cylinder engine; but even with reduced temperatures when striking the turbine, the very fact of requiring a reservoir for combustion to operate, and the forcing of the whole of the hot products through a relatively small nozzle, necessarily mean greater loss than I have assumed. Assuming, however, no more loss than I have given, an engine with an efficiency of only 16½ per cent. of the total heat given to it could not compete with internal combustion motors of existing construction. It may be said that the advantages of continuous rotation are so great that even at this low efficiency the gas-turbine would be successful. Personally, I doubt it very much, because the mechanical difficulties with gas-turbines would be much greater than the mechanical difficulties of the steam-turbine. In all steam-turbines, as you, I am sure, know, it is necessary to work with relatively small clearances between the tips of the blades or shrouding and the enclosing casing. This is also true as to endwise clearance between the fixed and moving blades. Comparatively, small clearances are necessary for economy.

The use of temperatures even so high as 400° or 500° C., by introducing unequal expansions, greatly increase the difficulty of obtaining economy. No doubt if a plentiful supply of relatively low temperature gases under considerable pressures could be obtained, these gases might with advantage be expanded in a nozzle, and used to operate a turbine. To carry this idea into effect has already been attempted, as I have said, by Mr. Lanchester; and there is some hope of operating in this way. I fear, however, that the temperature of the gases in the exhaust in the gas-engine are too high, as they stand, to be so used. Gases, however, from an exhaust or air supercompression engine, such as I have lately been working with, could no doubt give considerable efficiencies in turbines. I do not see, however, any solution of the gas-turbine problem here, because the amount of energy available for the turbine after the gases leave the gas-engine is too small for consideration in connection with any really high-power machines.

Some of the difficulties I have discussed with you have been mentioned by Dr. Lucke. He adopts the view that jet expansion is not so efficient as piston expansion; and here I agree with him. No doubt the type of jet expansion has to be carefully considered, and the efficiency of a jet as a means of converting the expansion from a high pressure to a low, into kinetic energy, depends entirely upon its configuration, and the design of the proper areas and relative lengths for the nozzle. All this, however, is as yet a relatively new field; and much study will be required before any certainty can be attained in the design of expanding jets. Professor Reeves, in another able article which I have already mentioned, differs from Dr. Lucke, and considers that he has over-stated the difficulties of the expanding jet. He accordingly takes a more favorable view of the turbine problem. There is a great deal of truth, however, in what Dr. Lucke has said. Even the best expanding jets yet known appear to have a low efficiency; and nothing is known of the efficiency of expansion starting from flame temperatures. Apart from the mechanical efficiency of the expansion, as I have already pointed out, the loss of heat due to conductivity will be great in such nozzles. I quite agree with Professor Reeves, however, that the more hopeful line for the gas-turbine lies in the use of steam to provide the working fluid under compression without a compressor, and in the heating of this steam when produced by a very small quantity of combustible mixture of gas and air under pressure. Such a turbine would be a compromise between what I may call the flame-turbine and the steam-turbine, and it presents more possibilities; but its efficiency would not be high, although, no doubt, such a machine could be got to operate mechanically with fair success.

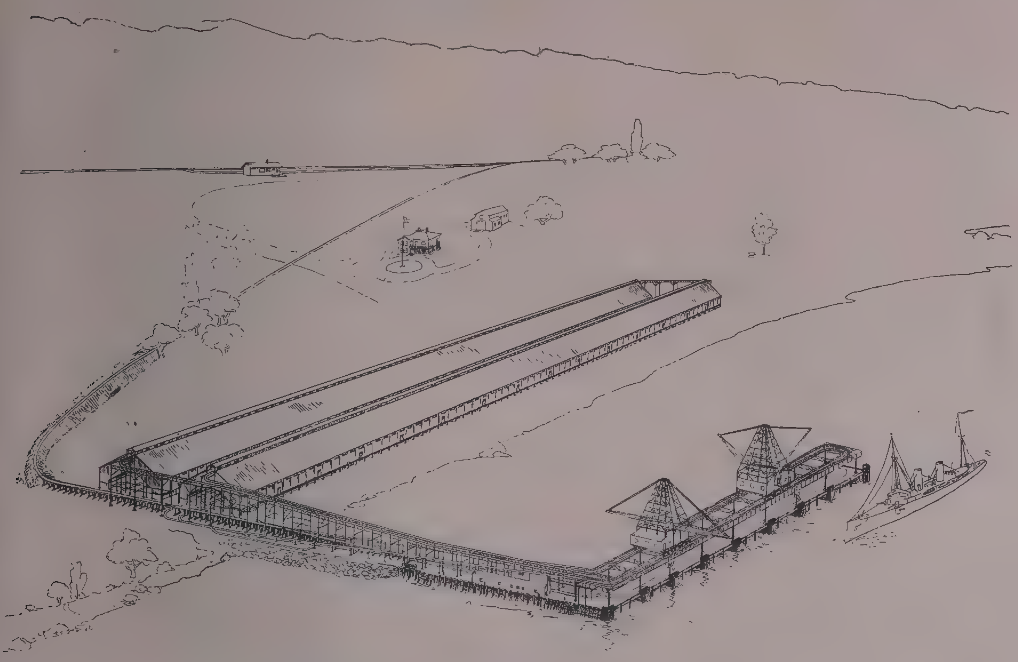
This line of work depends upon the fact that negative work may be greatly reduced by using steam as working fluid, when steam is heated highly by the internal combustion of a relatively small amount of inflammable gas and air. This proposal is more hopeful; but, for success, even it requires temperatures, in my view, too great for existing turbines to stand with economy. This proposal may be considered to be analogous to that of an excessive superheat, as used in an existing steam-turbine.

Many methods have been discussed which depend upon the use of regenerators. I have a great distrust of regenerators, so far as engine work is concerned. Many able men have proposed regenerative contrivances, from the time of Stirling, in 1817, down to the present day; but I am not aware of any actual working engine which has ever succeeded in practice, using a regenerator.

From what I have said, you will see that my view of the future of the gas-turbine is not favorable. But, notwithstanding, the subject is so fascinating that many inventors and scientific men will doubtless continue to investigate the problem; and possibly new solutions may be discovered which are not dreamed of to-day. I am the last man in the world to deprecate daring in any practical and scientific work; but I would advise the junior engineers—members of our Institution—to avoid the subject, except as a scientific study. I fear there is little hope for a young man to make a position and a business success of any internal combustion turbine, so far as present knowledge carries us.

The New Coaling Station at Narragansett Bay.

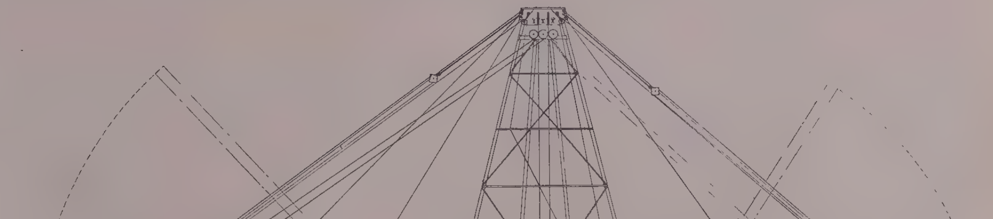
Narragansett Bay is one of the most important of the harbors available to the North Atlantic squadron of the United States Navy, occupying an intermediate position between New York and Boston, and offering the advantages of a sheltered harbor for vessels of the heaviest draught. One of the most important improvements made there by the Navy Department is the new coaling station recently completed at Bradford, near Newport. The storage building here is one of the largest covered coal storages in this country, providing for 60,000 tons, and unusual features of construction have been incorporated in it, which make the plant of more than ordinary interest. The storage of so large a quantity of bituminous coal alone introduces problems which will appeal to those experienced in the handling of this fuel as of a very difficult nature.



General Arrangement of Wharf and Storage Buildings of the New Bradford Naval Coaling Station.

The plant is on the east coast of the bay, about 12 miles up from its mouth, where a well-sheltered position in the lee of a small island was available and yet had a depth of water permitting the mooring with safety of the largest battleships. The village was formerly known as Portsmouth, but has been renamed in honor of Rear-Admiral R. B. Bradford, chief of the Bureau of Equipment of the Department of the Navy. A level site of 40 to 50 acres, from 10 to 20 ft. above high-water level, was secured for the storage buildings. A depth of water suitable for the dockage was available at about 500 ft. off shore at this point, the depth ranging from about 15 ft. at 200 ft. from the shore line to approximately 30 ft. at 500 ft. distant.

General Arrangement.—The arrangement of the pier and storage sheds of the Bradford plant are well shown in accompanying illustrations. The coaling wharf is a steel pier 400 ft. long by 55 ft. in width, which parallels the shore line and is connected with it by a 300 ft. approach wharf which leads from an embankment projecting about 200 ft. from the shore to the northerly end of the main wharf. The two steel and concrete storage sheds are each 725 ft. long and 87½ ft. wide, also parallel to the shore and so situated as to permit easy access for the tracks leading from the approach wharf to them. This parallel arrangement of buildings is favorable to further extension of the plant inasmuch as additional sheds may be added without disturbance of the present arrangement. A coal handling system of very complete detail has been installed, consisting of two traveling unloading towers on the main wharf and four lines of tracks for cars to convey the coal to and from the storage. These towers are of steel and span the wharf and lines of tracks, their booms projecting from either side for unloading from boats.



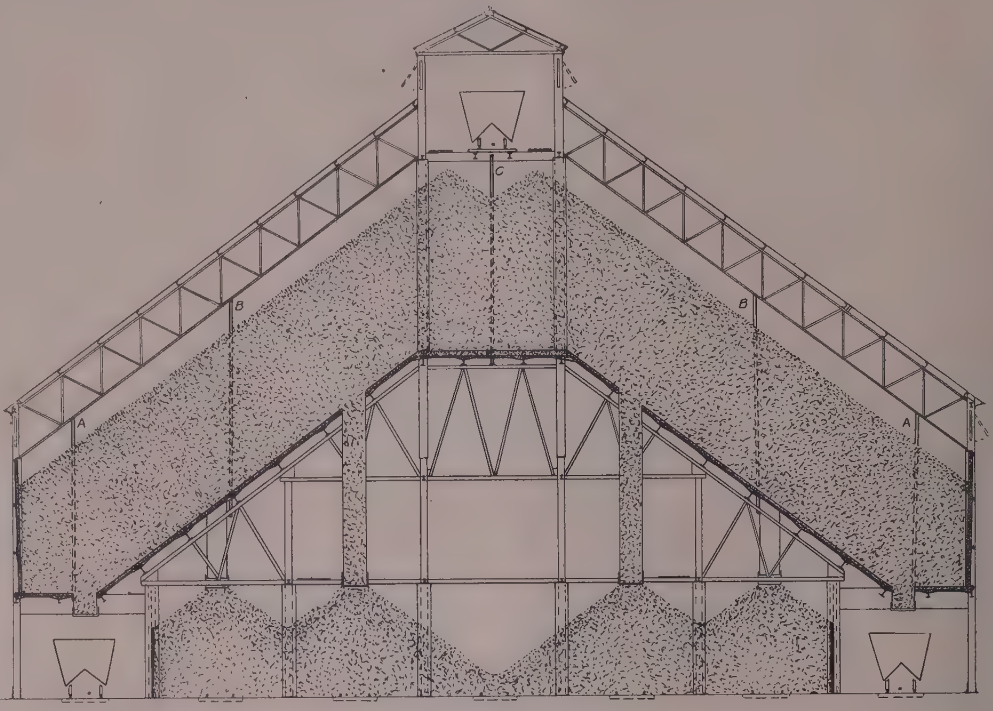
End View of Main Wharf and Coal Tower, Showing Methods of Handling Coal.

The steel frame of the main wharf is carried on nine heavy piers, 48½ ft. apart on centers. These are of cut stone from the tops down to 12 in. below the mean low water line, below which they are of dry stone, spreading out to a footing of 16 x 54 ft. on the gravel bottom of the bay. The wharf is carried on six lines of 48-in. plate girders, 10 ft. between centers and stiffened by diagonal bracing. The wharf structure is protected at the corners by clusters of 24 oak and yellow pine piles drawn together at the top by chains, and at intermediate points by groups of 10 piles driven in front of the foundation piers, and supporting boom fenders or dolphins.

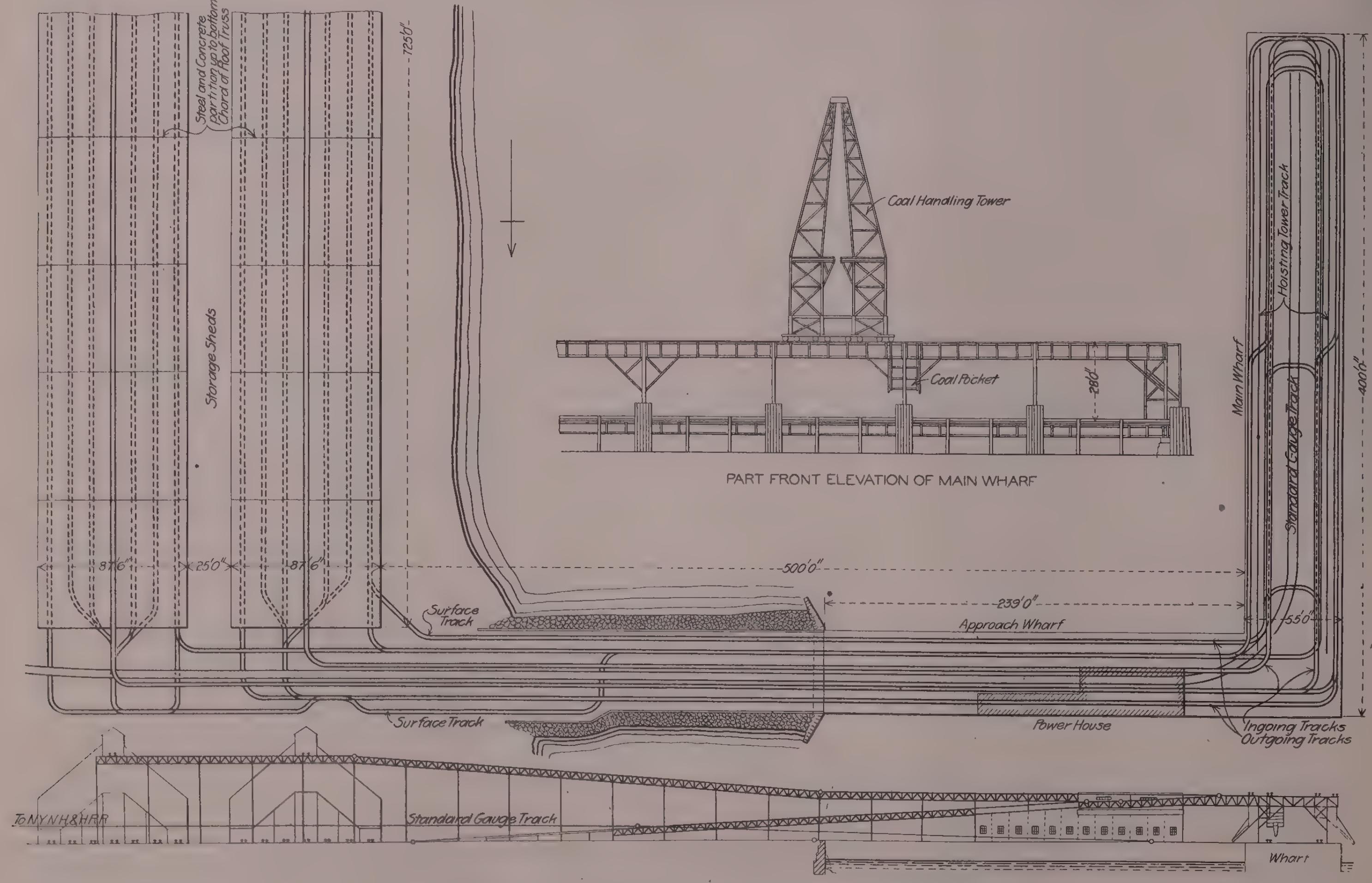
Steelwork.—The wharf is surmounted by a full length steel superstructure or viaduct carrying the four level lines of narrow-gauge coal car tracks and the 40-ft. gauge track of the traveling towers. It has two longitudinal rows of vertical posts from the foundation piers, 28 ft. high and 40 ft. apart transversely on centers, which support longitudinal and transverse lattice girders 6 ft. deep, web-connected to their upper ends. The transverse girders cantilever about 7 ft. beyond the posts at each end to carry the outside lines of coal tracks clear of the traveler rails, which are laid on the post centers. Each transverse bent is stiffened by 45° braced knee-braces extending from the second panel point of the transverse girder to a point 14 ft. below the top of the post and affording abundant clearance for the standard gauge track on the center line of the wharf and the two narrow gauge side tracks.

The traveling coal handling tower has a 44 x 40-ft. base with four vertical posts 32 ft. high, arranged in two longitudinal bents. Each bent has a bottom sill with four two-wheel trucks and has angle bracing in the panels between the posts and horizontal members. The end posts of the two bents are connected by transverse lattice girders at the top and by transverse plate girders 30 in. deep and 8 ft. in the clear above the rail, thus affording clearance for the surface tracks through the tower. The vertical posts and transverse trusses support the pyramidal upper part of the tower 68 ft. high and 6 ft. square at the top, which is made with sixteen inclined posts with horizontal struts and diagonal bracing on every face. The tower has two arms pivoted to it at the base of the pyramidal top, in the centers of the transverse faces. One of them is 64 ft. 9 in. long and the other is 79 ft. 9 in. long; both of them are 12½ ft. wide at the pivot, with a pair of trolley track plate girders in the center and lateral bracing each side and taper to a width of about 2 ft. at the extremity. Each has a capacity of 20 tons at the extreme point of trolley travel. Their normal position is horizontal, but they may be raised to clear vessels and are supported by their pivots, by tackles at the outer ends, and by adjustable intermediate guys from the tower top.

Storage Buildings.—The storage buildings are two steel-frame sheds located side by side near the shore line, each of which is 725 ft. long and 87½ ft. wide. These sheds, while conforming to usual practice as regards the roof structures, which have a slope corresponding to the natural inclination of the sides of a coal pile, depart from the usual construction in also having an A-shaped floor similar to that of the roof, the purpose being to distribute the coal naturally from the central point of delivery to the extreme sides of the bins. Each shed supports and shelters a distributed pile of coal of about 15-ft maximum vertical depth, the storage volume for which provision is made being equivalent to a horizontal pile about 105 ft. wide, 12 ft. deep and 725 ft. long, which, allowing a volume of 45 cu. ft. per ton of bituminous coal, amounts to over 20,000 tons. The spaces below the inclined floors around the columns, occupied by the tracks for the coal handling cable-railway lines, has also been adapted to the sheltering and storage of coal, if found desirable, by the installation of a cement flooring, giving an additional storage space for fully 10,000 tons. Each shed has thus a total capacity for 30,000 tons, making the total storage for the station 60,000 tons.



Typical Cross-Section of the Storage Sheds, showing Temperature Tubes.



Plan of the New Bradford Naval Coaling Station at Narragansett Bay.

A feature of their construction is that each side bay is unobstructed by columns, the roof structure consisting of inclined lattice girders paralleling the slope which the coal pile will naturally assume and carried from the extreme side columns of the building to the central rows of columns which support the elevated distributing tracks, monitor, etc. The flooring of each shed is carried by eight rows of columns spaced 12½ ft. between centers, on which rest transverse trusses to form the 36° inclination of the floors. On these rest the longitudinal 12-in. I-beam members of the floor, spaced 5½ ft. apart on the inclined surface, which carry the concrete flooring. The sheds have galvanized corrugated iron covering upon both roofs and sides.

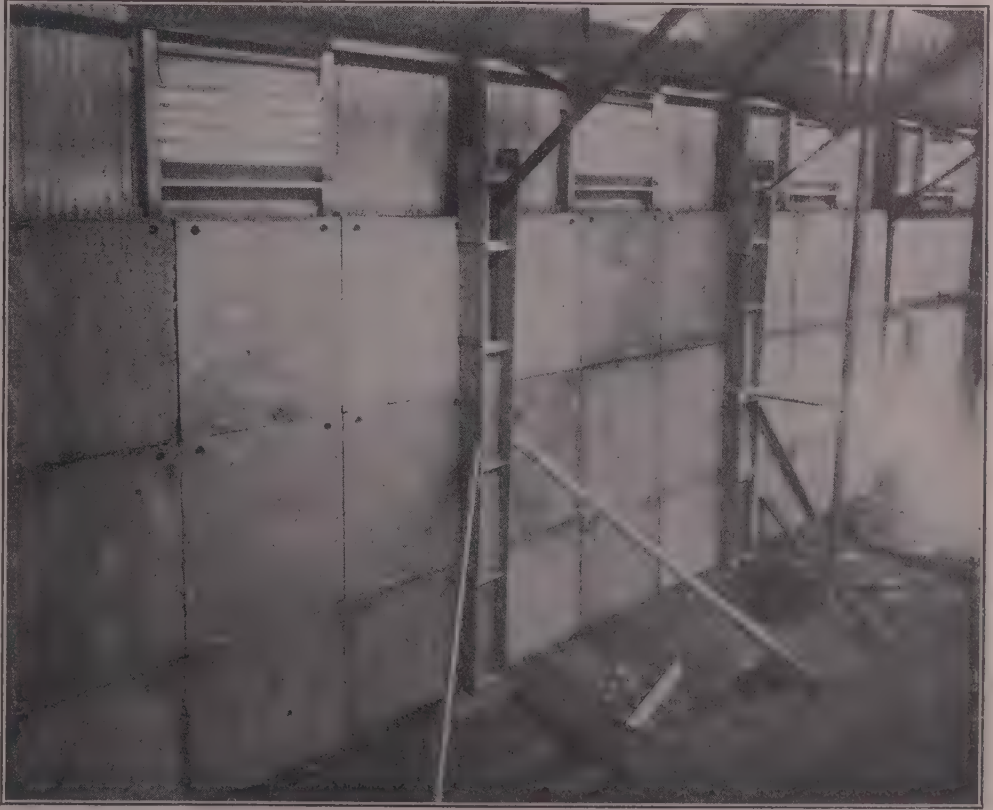
Concrete Construction.—The inclined floor is 6 in. thick, partially embedding the I-beams, and is reinforced with electrically welded fabric, furnished by the Clinton Wire Cloth Co., and stretched tightly across the upper faces of the beams. In the application of the concrete, three forms were used to a panel for convenience of handling. These were fastened rigidly in place by special lugs permitting of easy and accurate adjustment. It was found necessary to use very dry concrete on the inclined surfaces in order to prevent creeping. The Clinton fabric, tightly stretched above the forms, was found to offer an excellent surface upon which to slide the scoops used for transporting the concrete to the places where it was required. After the flooring was completed the surface was given a granolithic coating.

Reinforced Concrete Construction of Inclined Side Floors of Storage Shed.

The method of placing the concrete blocks of the sidewall construction was unusual. Owing to the expense and almost impossibility of getting concrete perfectly mixed in 4-in. walls when poured between vertical forms, slab construction was adopted and over 4,000 slabs 4 in. thick and about 4 ft. square were made. After setting and drying these were hook-bolted into position against the framework. These blocks are reinforced with the Clinton wire fabric of 4 x 4-in. mesh, cut to 4 ft. squares, and placed three-quarters of an inch from the outer surface.

The details of this method of block construction which was originated by the contractor, Mr. Augustus Smith, are illustrated in the accompanying drawings. The blocks are fastened against the horizontal I-beam members of the sidewall, which are set so that the blocks will incline outward for assistance in placing them. Each block has at its top edge thimbled holes for hook bolts, which are clamped under the flange of the I-beam after the block is set back into place, special provisions having been made for ease in locating the hook bolts, as they were placed after the outer galvanized corrugated-iron siding. The upper edge of each block was beveled so as to form a pocket into which the block above rests. This construction is also applied to the partitions between the various sections of the bins, which are from 60 to 75 ft. in length throughout, each shed having 10 sections. The partitions are supported by heavy structural steel framework so as to withstand the thrust of the coal from a section that is filled.

The method of making the blocks in quantities consisted of moulding them in sectional forms adapted to stacking up as high as desired. After each block was completed, it was covered with a sheet of oiled paper and another block started in a form placed on it. The oiled paper permitted the blocks to be thus built up one above the other while green, with no danger of sticking together when dry. The method also permitted a great saving of space occupied by forms. It was also more convenient to locate the thimbles, one above the other, with this method, than by spreading the forms out over a larger area.



Interior View of Shed, showing Concrete Block Side Wall Construction.

For this construction over 30,000 tons of concrete were used, all of which was prepared in a mixing plant located opposite the middle of the buildings. Both the sand and the gravel were secured from an excellent deposit on the property and delivered to the mixers by narrow gauge cars. The concrete for the floor was delivered to the buildings in skips, which were hauled over platforms to the highest section of the flooring in either shed. This was used as a distribution platform, the skips being lowered down the incline upon either side for the side floors.

Precautions Against Fire.—The space below the coal pockets is divided by the floor columns into seven galleries, all of which have tracks for the narrow gauge cars extended through them for loading the coal for removal. The floor storage is confined to the middle five bays, the two on the outside being always maintained free for the cars to pass beneath the downspouts for delivery of coal to them. The spouts, which are of sheet steel, 24 in. square, with double valve outlet gates of a special design, patented by Mr. Augustus Smith, at the bottom project down through the floor over all but the middle line of track. For floor storage purposes, the entire surface has been paved with a cement flooring finished flush with the top of the tramway rails to present an unobstructed floor surface. The columns in this part of the shed are protected by concrete, mainly as a precaution in case of possible fire in a coal pile; also it will be the practice, if heating should occur in the bins above, to draw off the affected coal to the floor below in order to quench and cool it, when the column protection will be useful. In the outer rows of columns grooves have been formed in the concrete protection into which planks may be inserted for temporary partitions.

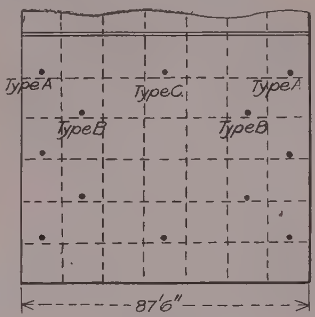
Temperature tubes have been distributed throughout the bin floors, so that if incipient heating should occur, as is sometimes the case in large bituminous piles, the fact will be announced immediately at the office of the superintendent of the plant. These tubes consist of lengths of 4-in. galvanized iron pipe, 17 to 20 ft. long, according to the location, set in the bin floor and projecting up through the coal pile. They contain thermostats of a standard design of the Navy Department, which are set to close their circuits at an external temperature of 150° Fahr. There are 232 of these installed in the storage sheds with circuits from each leading to a central annunciator in the office which thus gives a general alarm in case of incipient heating and also locates the trouble, so that coal may be drawn off from the section affected and allowed to cool. There are from ten to twelve of the tubes in each section between partitions, the greater number of which are located in the lower portions at the side, where the pressure upon the coal is necessarily the greatest. The temperature limit given the thermostats is low, but it has been determined by the Navy Department that coal undergoing incipient heating will increase very rapidly in temperature after having passed this point, so that safety demands a low setting in order to allow time for removal of the coal to the floor below before combustion commences.

Operation of Plant.—An accompanying end view of the main wharf and one of the coal towers illustrates the coal handling equipment. The towers provide for handling coal received in barges for transferance to the storage sheds or for delivery from the storage to vessels. For the former purpose each tower has a Rawson-Morrison coal digging equipment for unloading vessels, which delivers into a small receiving hopper in the tower from which delivery is made to cars of the cable railway systems. These buckets, which are of the clam-shell type, are of 1-ton capacity and capable of being operated at a rate of 100 tons each per hour. The receiving hopper in the tower, which is framed with steel and lined with heavy boiler plate, has a capacity of about 10 tons and is mounted on a cross track runway so that it can be rolled across to either side of the tower for delivery to cars upon either one of the inside lines of track.

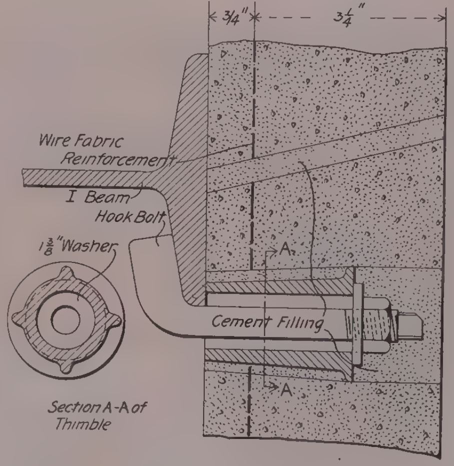
For delivery of coal to vessels there are several methods. The most simple is dumping the narrow-gauge cars by which coal is brought from the storage sheds, into the coal pockets along the side of the trestle, from which it is chuted directly into the vessels. Provisions are also made for sacking coal from the pockets for delivery by trucks to the decks of the vessels. Still another method consists of delivering from either the pockets or from standard-gauge coal cars upon the wharf below directly by the clam-shell diggers, into portable deck hoppers placed on the vessel, from which the coal is chuted below.

The pockets at the edge of the trestle, above referred to, consist of a continuous wooden apron surrounding the trestle beneath the outer line of cable track, which, with the vertical sheathing at the outside, forms a continuous hopper of large capacity into which the cable cars may dump directly at any point. The total capacity of this portion of the storage is 250 tons. The outer vertical sheathing has long wood lift doors which are geared for ease in handling and latch securely into place when dropped. For continuous delivery through any of these doors, there are four traveling chutes, two on either side of the wharf, which may be moved along a runway beneath the apron and located under the door. The door is hoisted open and cars on the cable railway then dump continuously, a 16-ft. portable dashboard preventing coal flying over the edge. At six points around the edge of the trestle, there are enlarged hoppers of about 15 tons capacity, which are used for coaling tugs and smaller vessels without starting up the cable railway system.

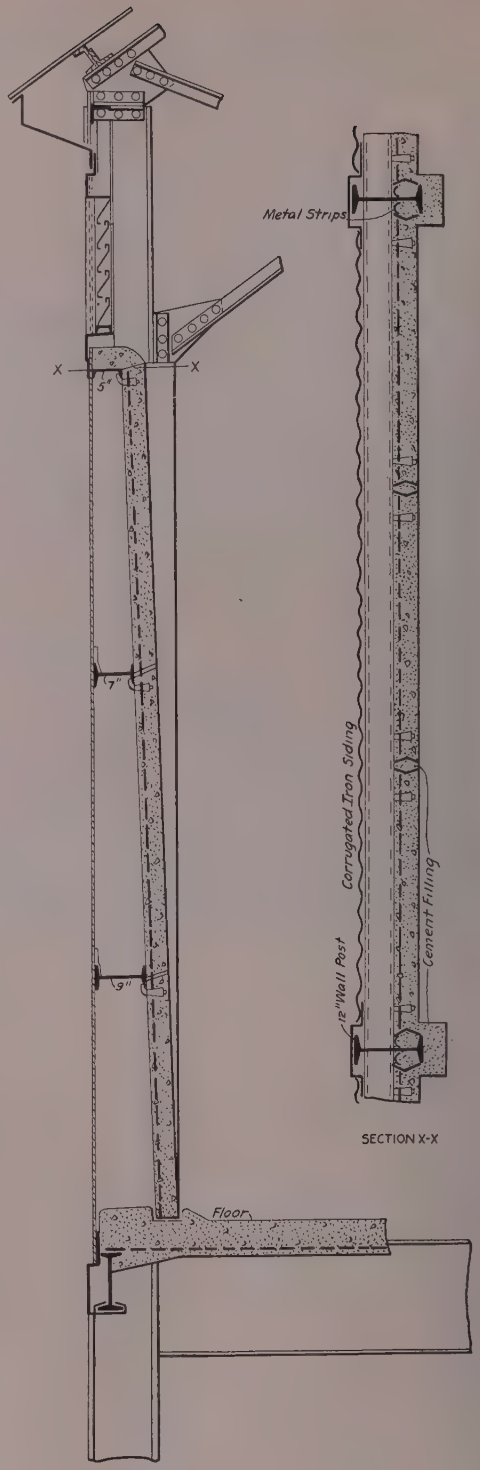
Each tower has in its base an individual power plant consisting of a 100-h.-p. vertical fire-tube boiler, a Rawson & Morrison double hoisting engine, and an engine for moving the tower. The machinery is protected by a corrugated-iron sheathed enclosure with numerous windows to enable the operators to observe the work outside. The boilers are 11 ft. high by 66 in. in diameter, with 300 2-in. tubes, and have 30-in. steel stacks 25 ft. high to clear the tower. The hoisting engines are of the direct-acting bucket and trolley type, self-contained on a combined frame, the bucket engine having 14 x 24-in. cylinders and a 24-in. drum, and the trolley engine, 10 x 12-in. cylinders and a 12-in. drum. Friction clutches with broad renewable leathers are used on the drums. The other engine is a 10 x 10-in. vertical reversing type with throttling governor and drives through jaw clutches and gearing. It is used for both moving the tower and lifting either one of the booms, the arrangement of clutches permitting all of this to be done simultaneously or independently. The 16 wheels of each tower run on two lines of 60-lb. rail laid on top of the 6-ft. side girders of the trestle, special track clamps being provided to lock the tower in any position.



Distribution of Temrerature Tubes in a Section of the Shed.



Hook-Bolt Method of Fastening the Blocks.



Concrete Block Side Wall Construction.

The railway between the wharf and the storage is a 30-in. gauge system embracing over 3 miles of track, a large portion of which is equipped for cable haulage. All the tracks at the storage sheds and on the main wharf are level, while those on the approach wharf are on a grade of 7 per cent., two leading upward to make connection to the central overhead dumping tracks in each shed and two others sloping in the opposite direction to deliver cars loaded from beneath the coal storage sheds up to the tower trestle. These inclined tracks and those upon the wharf trestle and above the sheds are cable operated from a power plant located on the approach wharf, similar to that of the tower power plants. There are over 100 side-dumping cars, each of 2 tons capacity.

The tracks are arranged in pairs connected at both ends by loops, so that the cars have a continuous movement around the circuit, always in the same direction and on the same track. At the entrance to the main pier and at the entrance to the storage shed, switches are provided connecting the incoming and outgoing tracks in the former case, and loops and spur lines in the latter case, so that cars may be diverted from one service to the other, or may be returned to their tracks without passing over the several loops in the continuous line of the lower grade tracks. The spur tracks in the lower portion of the storage tracks are graded to return the unloaded cars by gravity. Cars are filled at the storage sheds either directly from the outlet chutes beneath the bins, by shoveling from the floor or from a receiving hopper in the standard gauge railroad sidetrack, which passes above the cable railway tracks. The capacity of the system is limited by the fact that cars are always weighed at the top of the incline, yet a speed of delivery of 240 tons per hour was easily attained in the final test made on Oct. 7, and it was found that a speed considerably in excess of this could be attained. Coal may also be delivered directly to the wharf by standard gauge cars, the railroad spur track which enters the property extending out the full length of the wharf.

The Bradford coaling station was designed throughout and built by Mr. Augustus Smith, engineer and contractor, New York. The design was approved by Rear-Admiral R. B. Bradford, formerly chief of the Bureau of Equipment of the Navy Department. The coal-handling machinery and hoisting engines in the tower were built by the Mead-Morrison Mfg. Co., New York.

Waterproofing Brick Arches.

Waterproofing the brick arches of the masonry viaduct of the Pennsylvania R. R. in Wilmington, Del., is being done in the following manner: The masonry is first smoothed over with cement mortar. This is then covered with a special compound on which a layer of Hydrex felt is laid so as to lap at least 12 in. on the transverse seams. Five layers of compound and five of felt are used and special attention is paid to securing tightness around the drain pipes and at the spandrel walls. In fact the belt is carried up the back of the latter and turned into the joint under the coping about 2 in., where it is held with cement mortar. The waterproofing on the arches is protected with 1 in. of cement mortar and that on the walls with a single course of brickwork.

View Beneath Shed, Showing Protected Columns, Narragansett Bay Coaling Station.

Gold and Silver Production in the United States in 1904 was in satisfactory condition, according to the figures recently published by the U. S. Geological Survey. The output of gold was 3,910,729 fine ounces, worth $80,835,648, the greatest output in the country's history, and particularly gratifying after the falling back that occurred in 1903. The greatest increases were in California, Colorado and Nevada. The silver production was 55,999,864 fine ounces, worth $32,635,378. Its value ranged from 55 to 61 cents per fine ounce, considerably more than in 1903.

Segregation in Steel Ingots.

In the introduction to a paper on segregation in steel ingots, read before the Iron and Steel Institute, Mr. B. Talbot apologized for introducing a subject known in a general way to all steel makers and engineers, which there was even a tendency to ignore in some quarters as hardly advisable to investigate too closely. There is no question about the importance of the subject in the eyes of many steel users, however, and the substance of his paper is accordingly reprinted here:

The fact that segregation takes place in ingots appears to have been first discovered by Mr. Stubbs, Mr. Talbot says. He brought it before the notice of the Institute in the discussion on a paper by Mr. Parry, read in 1881. The subject was then taken up by Mr. Snelus, who published his results in the same year, completely confirming Mr. Stubbs's earlier observations. Some years later Mr. Eccles read a paper before the Institute on an imperfection in mild steel plates considered chemically, in which the effects of segregation in plates were clearly set forth. Since that date other observers have from time to time drawn attention to the subject—Mr. Hogg, in his paper read before the Society of Chemical Industry, and Mr. Pourcel, in his paper read at the Chicago meeting of the American Institute of Mining Engineers in 1893. There is also a good résumé of the subject in Howe's work on the "Metallurgy of Steel."

Although these papers draw attention to the effects of segregation in ingots and rolled products, very little appears to have been published as regards any means of lessening the amount of such segregation. It appears to have been pointed out by Pourcel as early as 1893 that aluminum has a decided tendency to prevent segregation, but Mr. Talbot has not met with any systematic series of tests to prove the point. His results of parallel tests made on ingots from the same heat, with and without the addition of a small amount of aluminum to the ingot, may prove of interest.

The ingots taken for examination were from both acid and basic open-hearth furnaces, and varied in weight from about 1½ to 3½ tons; and it may be noted here in passing that the smaller ingot showed the effect of segregation quite as distinctly, if not more so, than the bigger ingots tested. The height of the ingots was about 5 ft. 6 in., and the drillings were taken over the whole surface of the divided ingot. The results are stated in a number of voluminous tables, which lead the author to the following general conclusions:

As a rule, the results show that in the case of ingots to which no aluminum has been added, excessive segregation down the central line of the ingot occurs from about 6 in. from the top to about half-way down the ingot, that sulphur is the element which tends to segregate most, phosphorus next, followed by carbon, and, finally, manganese, the segregation of which latter element is so slight as to be almost negligible. No silicon determinations were made, as the amount of this element present was extremely small.

Perhaps the chief interest in the results consists in a comparison of the segregation shown in the case of an acid steel ingot, with and without the addition of aluminum, to an ingot from the same cast of steel. The amount of segregation of the sulphur in these two ingots shows a very marked difference. No comparative tests were made in the case of basic steel with and without the addition of aluminum. As it became the established custom at the works always to add a small amount of aluminum to all ingots, the author at the time did not consider it important to have this done, considering that the influence of a small amount of aluminum in decreasing the area of segregation had been already sufficiently proved.

In order to prove the importance of leaving the ingot always in a perfectly upright position, until sufficient time has been given to allow the center to solidify, an ingot was taken immediately after being cast, and while its center was still quite fluid, it was inverted so that the base stood uppermost. After cooling in this position, the ingot was cut open and analyzed. As was to be expected, the most segregated portion was here found in the end which had been allowed to cool uppermost; that is, the broad end of the ingot, although this was the original bottom end. The ingot from the same cast, which was not inverted, has, of course, the segregated area in the normal position.

Another point to which attention is drawn in analyses of fairly high carbon basic steel, made from a phosphoric mixture, in which the carbon has been raised from dead soft to about 0.5 per cent., is the regularity in the percentages of carbon obtained by the addition of solid carbon to the steel while running into the ladle. Continental writers have several times lately questioned whether sufficient regularity can be obtained by this means, and Mr. Talbot draws special attention to these analyses of carbon, as he considers they show the groundless nature of these statements.

An examination of the results shows clearly that by the use of aluminum a billet of a much more regular composition is obtained. This is especially important in the case of carbon, especially if this steel had, without aluminum, been intended for rail purposes, as the surface of the rail would probably have shown considerable irregularities in the carbon percentage, with a consequent want of uniformity in its wearing properties.

In cases in which the carbon has segregated to the center it is obvious that corresponding areas will be found at the sides in which the carbon is less than the mean, through the carbon having migrated to the center to a greater or less extent.

As in cases in which aluminum has been added the segregation is lessened, the distribution of the carbon over the surface of the ingot is found to be much more even, and to approach more nearly to the composition given by the ladle test.

To trace the effect of segregation when the ingot is worked down into billets, and to show the influence of aluminum in lessening the effect of segregation when the steel is rolled into billets, the following test was made: Two ingots from the same heat, were rolled into blooms. The ingots were 18 by 22 in. square, of acid open-hearth steel; the weight of each ingot being 6,000 lb., and the analyses of the ladle test of the heat being C, 38; S, 061; P, 052; Mn, 52 per cent. To one ingot no aluminum was added, while to the others ¾ lb. of aluminum was added. As the effect of the segregation is almost entirely confined to the top third of the ingot, only this portion was analyzed. Drillings were taken with a ¾-in. drill at the center of the billet, and also at ¾ in. from the side.

Although the results show that the influence of the aluminum did distinctly lessen the effects of segregation, as shown in the billet, still segregation could be very distinctly traced. Tests were also made in the same manner on billets rolled from steel made in the basic furnace, and in this case the effect of segregation seems considerably localized, and appears to a marked extent only in one spot—that is, in the center of the section taken between the second and third billet. The following are the particulars of this test: The ingot was 20 by 24 by 65 in. and was top-poured and 10 oz. of aluminum was added to it in casting After casting, the ingot was allowed to cool in its original position. After cooling, the ingot was reheated and bloomed down to 6 by 6¼ in. After rolling to this size, the ingot was cut up into small billets, as follows: First, the regular crop was cut off, then a small piece 6 in. long, then a billet 4 ft. 6 in. long, then another small piece 6 in. long, then another billet 4 ft. 6 in. long, and so on until the whole ingot was cut up and twelve small pieces each 6 in. long had been cut from the same. From these small pieces drillings were taken from the centers and sides and analyzed. The center drillings were taken from holes ¾ in. in diameter by 1 in. deep, while the side drillings were taken from holes ¾ in. in diameter by ½ in. deep; the side drillings were taken from a point about ¾ in. from the ends of the piece.

In the twelve small pieces the average analysis at the center was carbon, 0.545; sulphur, 0.0674; phosphorus, 0.0391; manganese, 0.62. The analysis at the center of the third piece from the top, where the segregation appeared, was: Carbon, 0.71; sulphur, 0.135; phosphorus, 0.065; manganese, 0.57.

Another ingot from the same heat, and to which the same amount of aluminum was added, was inverted after casting and allowed to cool in this position. After reheating, the ingot was bloomed down to 6 by 6¼ in., and 6 in. pieces and 4 ft. 6-in. billets cut off, as before. In this case, of course, segregation was to be expected in the billets from the lower third of the ingot. In this case again, segregation was strictly localized. The average analysis from the center of the small pieces was: Carbon, 0.543; sulphur, 0.0642; phosphorus, 0.0404; manganese, 0.626. In the center of the next to the bottom piece, where the segregation was mainly concentrated, the analysis was: Carbon, 0.61; sulphur, 0.110; phosphorous, 0.064; manganese, 0.65.

So far as the author is aware, Pourcel was the first to point out that the addition of aluminum gives homogeneity to the steel. The analyses given in the tables certainly tend to confirm this view. The reason why this should be so seems somewhat obscure, and the author does not wish to put forward any view on the subject by way of explanation, but the following consideration may serve to throw some light on the question.

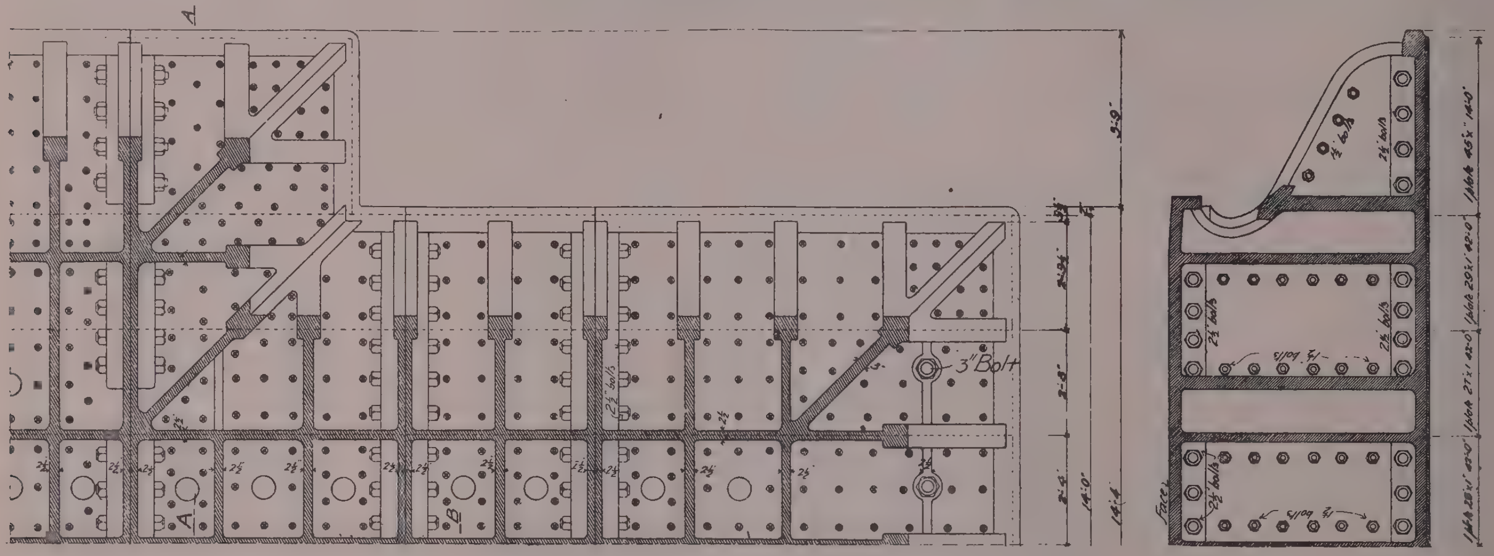
His experience on the addition of aluminum in the ingot mould during casting has always been that the aluminum appears to make the metal set quicker. This, he is aware, is against the view usually held by metallurgists. Thus, in Mr. Harbord's recently published book on steel, it is stated: "The addition of very small amounts of metallic aluminum to such metal" (i. e., metal containing dissolved oxides) "is found to cause a marked increase in the fluidity of the molten metal, to stop the evolution of gas, and to allow of the production of sound ingots without blowholes." Mr. Harbord, however, does not seem entirely satisfied with this view, as on the same page, in referring to Mr. Hadfield's classic work on aluminum steel, he tells us that, according to that investigator, it is doubtful whether aluminum increases the fluidity of properly-made steel. This latter view falls in with the facts observed by the author, under whose directions aluminum has been added regularly to many thousands of casts.

Not only does the addition of a little aluminum to the metal as it is run into the ingot have a marked effect in setting the surface, but it also, in the author's experience, tends, when added above a certain quantity, to form cavities in the upper part of the ingot, so that the amount added has to be strictly regulated. The setting effect on the top of the ingot is so marked that the works with which the author was connected, after it had become the custom to add aluminum regularly, the ingots were never sanded over or stoppered down, as no such treatment was necessary, either with acid or basic open-hearth steel. With mild steel also it was found that the moulds could be stripped sooner when aluminum had been added.

It was also observed that when the same quantity of aluminum—viz., some 3 to 4 oz. per ton of steel—was added to the metal as it ran into the ladle, its effect was not so pronounced as when added in the ingot mould as the ingot was being teemed. There appears, therefore, to be some contradiction in the facts observed, some authorities telling us that aluminum in small quantities increases the fluidity of the metal; others, with whom the author joins, contending that the reverse is the case. Theoretically, one would undoubtedly expect some increase in temperature, owing to the reaction between the dissolved oxides in the metal and the aluminum, an action akin to the well-known thermit process.

If an increased temperature is obtained, with the consequent increased fluidity, this would cause the steel to take longer to solidify, and would consequently tend to increase the segregation, provided that the aluminum has no special action of its own on the metal, whereas the numerous analyses made by the author prove that there is a considerable diminution in the amount of segregation. As the metal appears to set quicker, and as, consequently, segregation would be expected to be less, due to this quicker setting, the analyses seem to agree with this view. The author's usual practice was to add about 3 to 4 oz. of aluminum per ton of steel in the ingot, but this was never added until the ingot mould was approximately two-thirds full. Assuming the aluminum to be all concentrated in this top third of the ingot, it would then only be at the rate of about 12 oz. per ton, or about 0.033 per cent. aluminum.

In the author's opinion it would be well worth while for other investigators interested in the manufacture of higher carbon steel, such as for rail, tire, and similar purposes, to follow up these results with a view of proving whether a more uniform and regular steel is not thereby obtained, a result well worth the few cents per ton the aluminum would cost. Perhaps the chief result to be looked for would be the decreased amount of crop end that it would be necessary to cut off from the top of the ingot, due to the greater solidity of the top and the lessened amount of segregation in this top part of the ingot. This alone would undoubtedly pay for the cost of the aluminum added, without considering the more regular quality of the finished product as a whole.



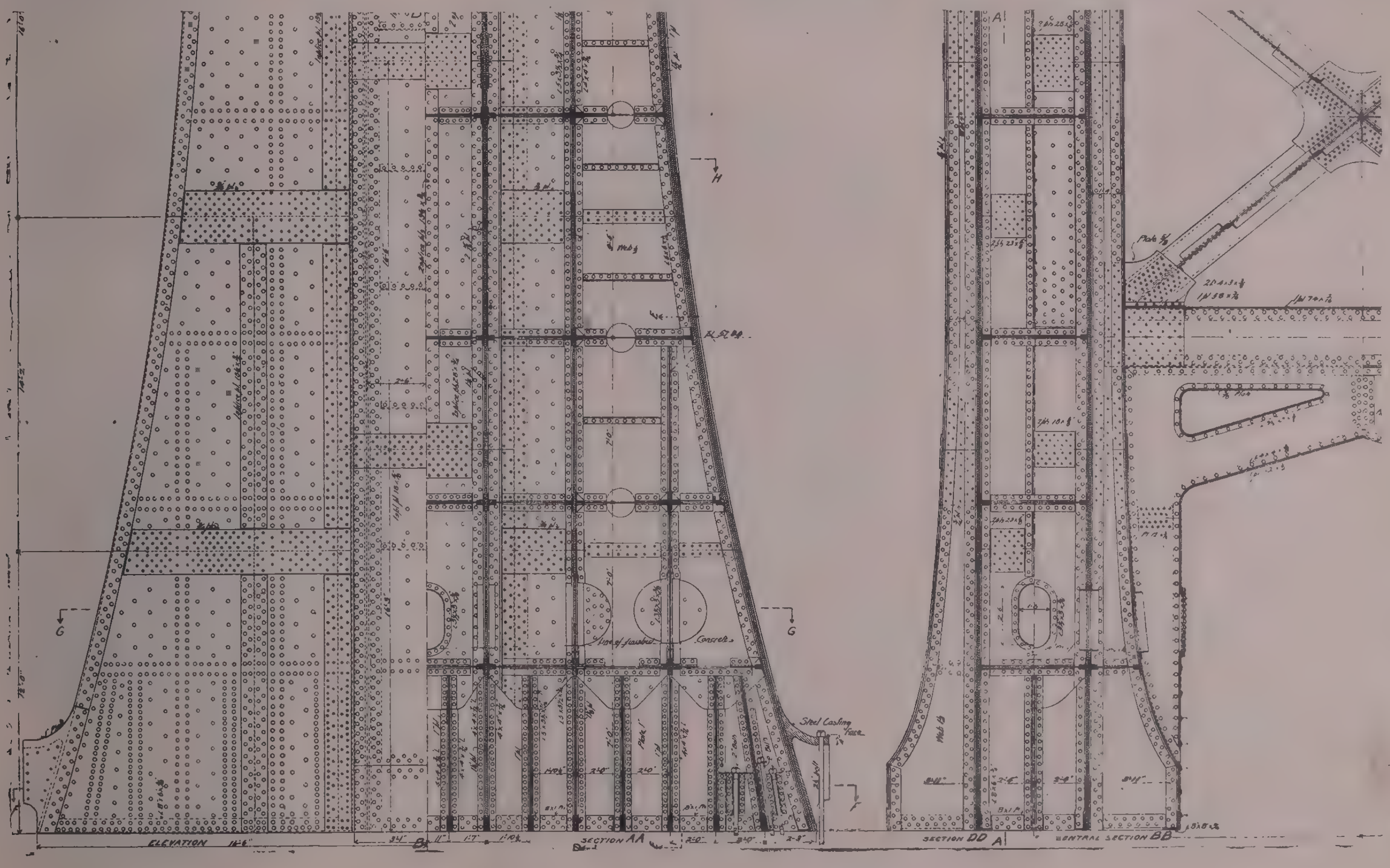
Quarter Sectional Plan and Half Transverse Section of Tower Pedestal.

The Design of the Post Base of the Manhattan Bridge Towers.

The Manhattan suspension bridge across the East River, New York, between the Brooklyn and the Williamsburg bridges, although about 130 ft. shorter in the main span than they, is designed for heavier loads, which, with certain special and original features of arrangement, have led to an unusual construction of some of the principal members. These are of interest on account of their enormous magnitude, their details and the care taken to make them conform not only to present shop and mill standards, but to anticipate some points not yet generally adopted in high-grade bridge construction.

The total length of the bridge, including approaches, is 6,854 ft. and the total weight of steel in the superstructure contract is about 41,700 tons, of which 9,000 tons is for the main suspended span and 9,700 tons for the two shore spans. The principal items of contract costs are: Brooklyn tower foundation, $470,000; Manhattan tower foundation, $503,433.90; masonry pedestals, $150,000; Brooklyn anchorage, $1,212,554; Manhattan anchorage, $197,000; suspended superstructure, $7,284,739; total, $10,817,736.90, for construction contracts. The exploration borings at the tower and anchor sites cost $18,530.96 and the engineering and office expenses up to January 1, 1905, amounted to $175,253.61, making a grand total of $11,011,521.47. The necessary land has not yet been all secured, but up to Jan. 1, 1905, the cost had been $2,606,594.19 for this item. The contract for the complete superstructure of the three main spans, including steelwork in the anchorages, the towers, cables and suspenders, was awarded to the Pennsylvania Steel Co., Mr. J. V. W. Reynders, superintendent of the Bridge and Building Department, and Mr. F. W. Cohen, engineer of erection. Legal questions have arisen concerning the contract which have prevented the commencement of the work for over three months and are yet to be settled.

The construction of the bridge was authorized on Jan. 8, 1900. Work was commenced on the tower foundations on May 1, 1901, and they have been completed and the anchorages are being now built as described in The Engineering Record of Dec. 17, 1904, Sept. 30 and Oct. 7, 1905. Considerable delay has been occasioned by important changes in the design, on account of changes in the policy of the bridge department, but work is now actively progressing on the amended design under which it should be finished so that the bridge can be opened for traffic in 1909, if no further legal delays are encountered.



Bottom Section of Tower Post, Showing Diaphragms and Braces.

The 1,470-ft. center span, about 135 ft. in minimum clear height above mean high tide, and the 725-ft. side spans, are suspended from four lines of 20¾-in. cables supported at an elevation of 322½ ft. above the river on steel towers 204.5 ft. high seated on granite and concrete piers. They are 120 ft. wide over all and have four lines of riveted stiffening trusses 24 ft. deep in three spans, with pin and rocker bearings at the tower piers. They have a 120-ft. lower deck with four trolley tracks, two sidewalks and one 35-ft. roadway, and two upper decks each carrying two lines of elevated railroad track.

The great static, live and wind load stresses developed are provided for by the use of nickel or high carbon steel, and although the large excess of dead over live load stresses in most of the members permits very high unit working stresses, the great dimensions of the bridge involve the use of unprecedented cross-sections in the cables and the towers. Although the cables will be the largest and strongest ever built, they will be made of the standard type with continuous straight wires and do not present any unusual features of design or, necessarily, of erection.

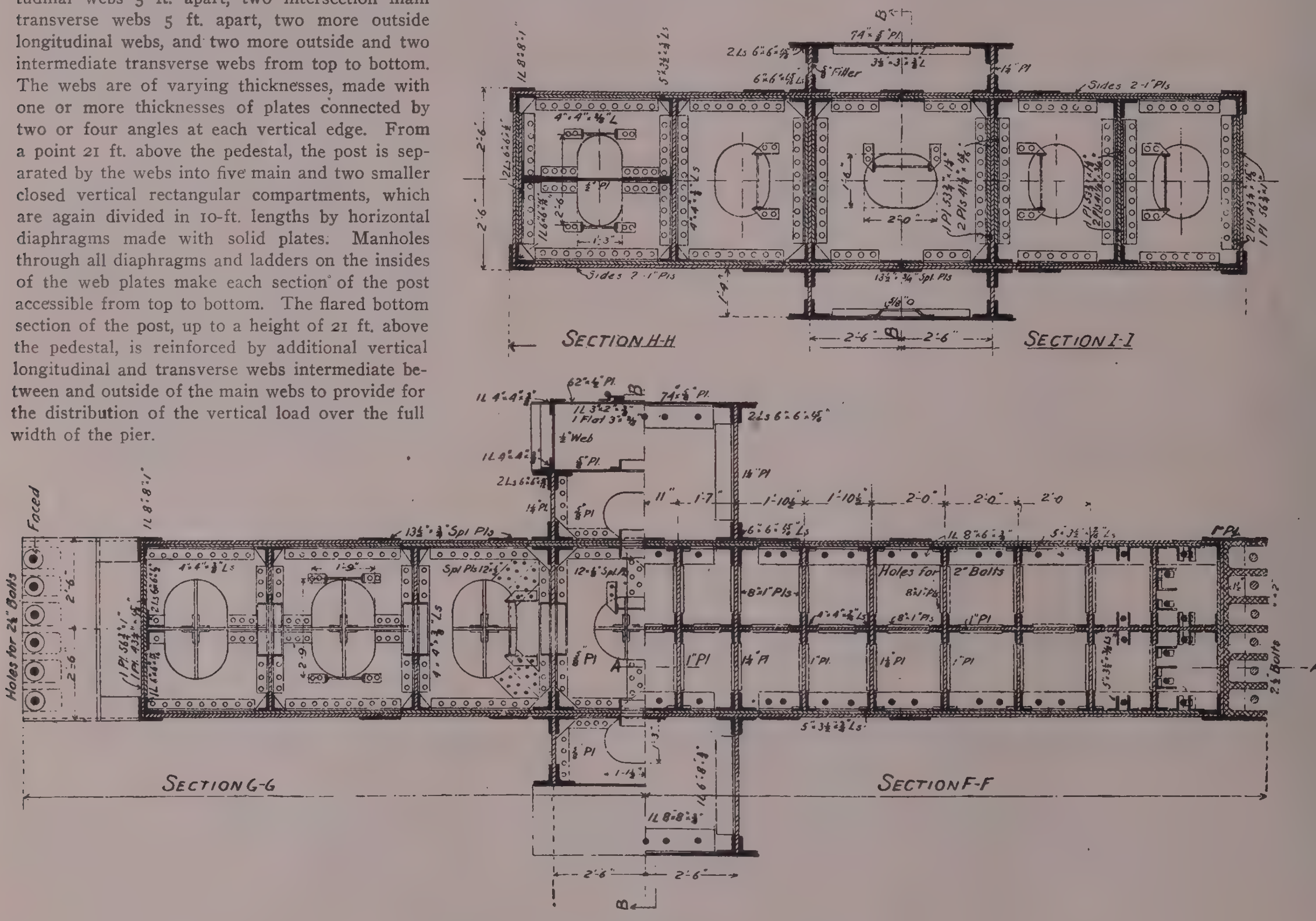
The towers weigh 12,500,000 lb. each and contain riveted members much larger and more elaborate than any ever yet manufactured or erected. The distribution of material in them and the practical difficulties of riveting it together so as to avoid ambiguity of stress and secure direct and positive action, has been a difficult problem. It has been solved with special regard to mill and shop facilities and so as to provide for all work except splicing to be done in the bridge shop and to limit the separate pieces to sizes which can be shipped on cars and handled in the field erection.

The towers are, strictly speaking, single transverse bents, each having four well-braced vertical posts. The bases of the posts are extended longitudinally to cover the full width of the pier top, and, as the cable saddles are rigidly fastened to the tower post tops, the effect is to make them act somewhat like rockers. They are not, however, true rockers, as the wide bases prevent their pivoting at the bottom, and the longitudinal displacements at the top due to temperature elongations and contractions of the cables cause the posts to spring back and forth through a computed maximum distance of 8 in. one way from the center line, thus acting like vertical cantilevers. This movement all takes place on the river side of the post and corresponds to a total temperature change of 110° and a vertical displacement of 2 ft. for the center span. The side spans are comparatively rigid and only rise and fall 0.2 ft. from mean position.

The towers are symmetrical about their center lines, as illustrated in The Engineering Record of July 29, and the two sides are braced rigidly together by heavy transverse girders and spandrel-braced arch portals just below the levels of the saddles, and at the upper and lower roadway decks 270 ft., 146 ft. and 95 ft., respectively, above the pier top. At each of these three levels the towers are enclosed by balcony platforms and the brackets which support them, as well as the ornamental tops over the cable saddles, the principal knee braces, and the hoods over the sidewalk passages, are gracefully curved to give the outlines as pleasing an effect as possible.

Each tower post is 281.89 ft. high from top of pedestal to base of saddle and has, transverse to the bridge axis, a uniform extreme width of 7½ ft. down to about 20 ft. above the pedestal, where it commences to increase with curved edges to a width of 12½ ft. at the pedestal. Parallel with the bridge axis the extreme width increases from 10 ft. at the top to 33 ft. at the pedestal. From the top to a point about 40 ft. above the pedestal the sides of the post taper in straight lines, below that level they diverse in tangent curves. Except for the connections for the transverse bracing the posts are symmetrical about their transverse and longitudinal center lines. The post has a rectangular closed cruciform cross-section with a uniform center rectangle 5 ft. square and varying proportions at different levels for the extensions from its four sides.

It is built throughout with two main longitudinal webs 5 ft. apart, two intersection main transverse webs 5 ft. apart, two more outside longitudinal webs, and two more outside and two intermediate transverse webs from top to bottom. The webs are of varying thicknesses, made with one or more thicknesses of plates connected by two or four angles at each vertical edge. From a point 21 ft. above the pedestal, the post is separated by the webs into five main and two smaller closed vertical rectangular compartments, which are again divided in 10-ft. lengths by horizontal diaphragms made with solid plates. Manholes through all diaphragms and ladders on the insides of the web plates make each section of the post accessible from top to bottom. The flared bottom section of the post, up to a height of 21 ft. above the pedestal, is reinforced by additional vertical longitudinal and transverse webs intermediate between and outside of the main webs to provide for the distribution of the vertical load over the full width of the pier.



Horizontal Sections Through Lower Part of Tower Post.

Each post is seated on a sectional cast-steel pedestal 5½ ft. high, 41 ft. 4 in. long and 21 ft. 10 in. wide, which weighs about 380,000 lb. It is made, as shown in the part plan and section, with six transverse pieces bolted together through vertical transverse webs. Both longitudinal and transverse webs have a thickness of 2½ in., except where they are increased to 4 in. in narrow strips to form bearings for the splice bolts 1½ in. in diameter, and to make curved stiffening ribs on the outer edges. The top and base plates are faced to respective thicknesses of 3½ and 2¾ in., and, like the vertical webs, have holes cored in them to provide for the removal of sand and the filling of concrete or grout. Bearings are provided in the outside sections of the pedestals for four 3-in. anchor bolts 12 ft. long, rough-threaded the whole length and set with grout in holes drilled in the masonry. Rolled steel plates 1 in. thick and from 21 to 45 in. long are countersunk-riveted to the base of the pedestal and bear on sheets of lead 1/16 in. thick interposed between them and the very carefully dressed and leveled surface of the pier masonry. The largest section of the pedestal weighs about 70,000 lb.

Each post is riveted up in the bridge shops in fourteen lengths of about 12 to 24 ft., and all but the upper length are in two or more pieces connected by vertical field-riveted splices. Up to a point about 145½ ft. above the pedestal each length is shipped in three pieces, the center one being composed of the 5x5-ft. section included between the main transverse webs and the two transverse extensions. In the upper part of the post each length is divided into two pieces on the center transverse line. The heaviest single piece weighs about 50 tons. All the post rivets are 1 in. in diameter and those in the bracing are ⅞ in.

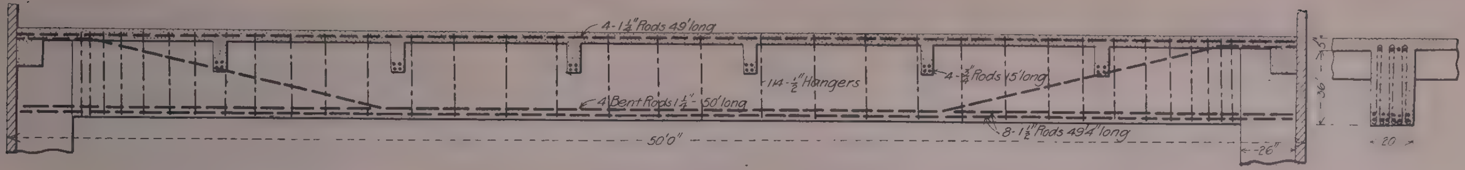
The 12-ft. lower section of the post is made, as shown in the sectional views, of vertical web and cover plates, from 1 to 1½ in. thick, and of four 8x8x1-in., twenty-eight 6x6x15/16-in. and 5x3½x¾-in. principal vertical angles, besides many pairs of 4x4x7/16-in. and 5x3½x7/16-in. short vertical angles for the connections of the longitudinal and transverse diaphragms in the lower part. All horizontal diaphragms are made of ⅝-in. plates and 4x4x⅜-in. connection angles and have 18x24-in. manholes with rounded corners. Both horizontal and vertical field joints are spliced with inside and outside ¾-in. cover plates.

The lower section of the post has no base plate, but the lower edges of the web plates, as well as the ends of the angles, are faced to bear on the top of the pedestal, to which it is secured by numerous 2-in. bolts through the horizontal legs of flange angles. Curved steel lug castings, 5 ft. long and 4 ft. high, and riveted across the transverse cover plates at the bottom of the post. Each has seven 2-in. webs and in each pocket between the webs there is a 2½-in. vertical anchor bolt passing through the pedestal into the pier masonry and having at the upper end a nut bearing on the faced top of the lug. The post is filled with concrete to a height of 8 ft. above the top of the pedestal, thus completely enclosing all the short bottom vertical diaphragms and the lowest horizontal diaphragm.

The lower strut and portal connecting the feet of the two posts on one side of the axis of the bridge are made, as shown in the partial transverse elevation, of two ½-in. vertical web plates in the planes of the main transverse webs, and, with the flange angles and bent cover plates, make closed rectangular members 5 ft. thick. The upper transverse struts between the lower parts of the posts are made of built channels having vertical webs, also 5 ft. apart, and 3x3-in. horizontal lattice angles on their flanges. The X-braces between them have I-shaped cross-sections 5 ft. deep made of two pairs of 10-in., 35½-lb. bulb angles, back to back, latticed with 3½x3½x⅜-in. angles.

The bridge is being constructed under the direction of the Department of Bridges of the City of New York, Mr. George E. Best, commissioner, Mr. O. F. Nichols, chief engineer, Mr. R. S. Buck consulting engineer.

Recent Overflowing of the Colorado River is reported to have cut a new channel on the Salton desert in Southern California, which has diverted a large portion of the flow and created a large lake in that famous desert.



Cross-Section of One of the Main Girders, Showing Details of Reinforcement.

A Reinforced Concrete Garage in New York.

The Robbins' automobile garage on West 93d St., New York City, is a three-story and basement structure, with reinforced-concrete floors and roof and brick side walls. The main part of the building is 50x100 ft. in plan, with an ell 32.5x36 ft. in plan, on one side at the rear. All the floors are designed to carry a uniform live load of 150 lb. per square foot. The floor space in all three stories is entirely unobstructed; the concrete floor slab of the first story rests on beams and girders carried by reinforced-concrete columns built up from the basement floor, while the slabs of the second and third floors and of the roof rest on heavy transverse girders, which are carried at each end by reinforced-concrete columns built in the outside brick walls.

Interior View of Robbins Automobile Garage.

The building has been erected for a general business in storing and repairing automobiles. The first story has a uniform height of 19 ft., the second of 16.5 ft. and the third 19 ft. at the front, which is reduced to 15 ft. at the rear by the slope of the roof. The entrance is on the first floor at the middle of the front of the building. A lift runs from the basement to the top of the building at the rear, through 10x16⅓-ft. openings in the floors, and serves the basement and all three stories. An office and an owner's club room are provided on the first floor, one on each side of the main entrance. The ell on the second floor is occupied by a chauffeurs' locker room and conveniences. A storage room is also provided on that floor at one side of the shaft for the lift. The repair room is on the third floor of the ell. A specially arranged room for washing automobiles is placed on this floor on one side of the shaft for the lift, and another washroom is also provided in the basement. A spiral iron stairway, which occupies a 9x13-ft. floor space, extends from the basement to the roof in the rear of the office room. Other than this stairway the lift shaft and the rooms mentioned, the floor space is entirely available for storing machines, the long-span girders avoiding interior columns in all parts of the building.

The building is on a residence street and abuts on each side against three-story brick and stone residences. Its front will be finished to harmonize with the surroundings. A granite base extends 5 ft. above the sidewalk. Above the granite, pressed brick and terra cotta are used, with a large percentage of the front on the second and third floors made up of windows, with ornamental iron frames. The side and rear walls are not exposed, and were built of ordinary brick. The building is designed to be thoroughly fire-proof, all of its floors except those in the office, club and chauffeurs' room, being finished in cement. The partitions are of terra cotta arch construction, plastered over. The lift shaft is enclosed and is provided with large, swinging kalemein doors on each floor at the front.

The basement of the building was excavated in good rock, on which the basement floor was laid and the columns carrying the first floor built. In the main part of the building the basement is divided into three bays by the outer walls and two rows of 12x12-in. columns, the columns being about 13 ft. 5 in. on centers longitudinally and 17 ft. 3 in. from the sidewalls. These columns carry 6x14-in. transverse beams and 8x18-in. longitudinal girders, which are built monolithic with the floor slab. The columns and beams supporting the floor in the rear of the building are of various dimensions, depending on the span. The second floor forward of the front wall of the ell is carried by 20x36-in. transverse girders on 13-ft. 5-in. centers. These girders are 50 ft. long, with a clear span of 45 ft., and are built monolithic at the ends with 24x26-in. columns carried up from the basement floor. The floor slab between the girders is carried by 6x14-in. cross beams, on 6-ft. 3-in. centers. The floor at the rear is carried by beams and girders supported by columns in the sidewalls and a column at each corner of the lift shaft. The girder and column system for the third floor is practically the same as for the second. The roof is designed for lighter loads than the floors, so its main girders are somewhat lighter than those carrying the latter. The slabs of all three floors and the roof are 5 in. thick. The De Vallière system of reinforcing is used throughout, plain round rods being employed. The concrete was mixed quite wet in the proportions of 1 of Vulcanite Portland cement, 2 of sand and 3 of ¾-in. broken stone, with the dust screened out.

The forms for the floorbeams were made of 2-in. plank dressed on one side. Those for the floor and roof slabs were made of tongue-and-groove flooring. The material for the centering was carefully selected and the best skilled labor was employed in building and erecting the forms, with the result that no patching whatever was required after they were removed. The concrete in the first floor slab and the basement columns and girders was mixed by hand. When the laying of the first floor was about finished a ½-yd. Smith mixer was set just in front of the lift shaft and the remainder of the concrete mixed in it. The mixer was placed enough lower than the first floor so the materials could be dumped directly into it from that floor. A Pelham hod elevator serving all the floors was erected in the lift shaft and concrete transported from the mixer to the various parts of the work in ⅓-yd., two-wheeled Ransome carts.

After the first floor had been laid about a week sand, stone and cement for the remainder of the work were stored on it without damage to the concrete. The sand was placed along one side of the building and the stone along the other, the stone pile being 5 ft. high and about 15 ft. wide. The cement was stored in a small shed in the ell and piled 8 ft. high. The forms for the second floor and its girder and beam system were being erected at the same time the concrete materials were being delivered. In order to leave a driveway open down the center of the building the main girder forms were supported on Howe trusses after they had been accurately placed, and the other forms supported on them. These trusses had two 2x10-in. planks for top and bottom chords and 2x8-in. planks for verticals, with 1-in. planks for diagonals. They were supported at each end by 6x6-in. timbers shimmed up from the floor. The forms throughout the rest of the building were supported directly from the floors below them.

The concrete laying in the floors and roof was finished in a little more than two months after the basement excavation had been completed. It was laid as nearly monolithic as possible. The girders and their supporting columns were always put in during one shift. Work on the beams and floor slab was stopped over the girder centers, whenever concrete laying had to be discontinued.

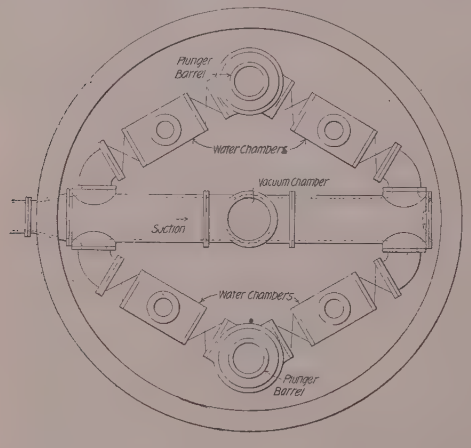
Building the forms, placing the reinforcing rods and laying the concrete for each floor required about two weeks. The concrete was entirely finished before work on the sidewalls was commenced. The masons carried the brickwork up from the inside, working on scaffolding carried on the floors except where the walls join the latter, at which places outside swinging scaffolds were used.

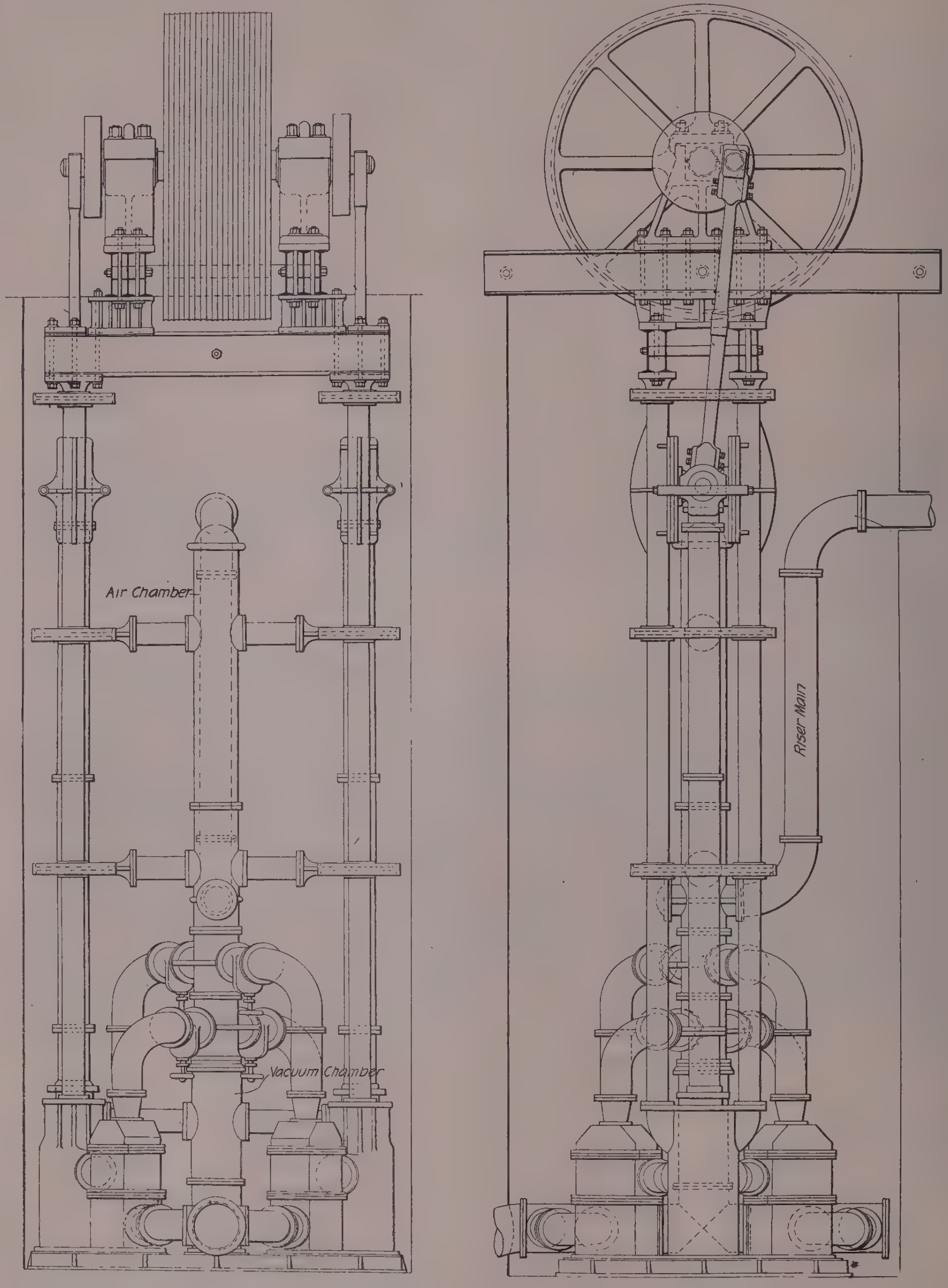
The building has been built for Mr. H. P. Robbins, of New York City, and was designed by Messrs. Snelling & Potter, architects, of New York. The Reinforced Cement Construction Co., of New York, designed and erected all the concrete work, the erection being superintended by Mr. W. T. Piper.

An Unusual Pump.

The water supply of Catlettsburg and Ashland, Ky., is drawn from the Ohio River and pumped to an elevated storage reservoir, from which it flows by gravity through the distribution systems of the two towns. The pumping station is located on the river bank and contains 4 boilers, 2 fired with coal and 2 fired with natural gas. The combined capacity of these boilers is utilized at present by a non-condensing compound pumping engine in an 18-ft. circular, brick-lined pump pit, 45 ft. deep below its top in the station building. The pump draws from a settling pool connected with the river, or from the river directly, and discharges against a head of 180 lb. into a riser main leading to the reservoir.

The installation is naturally uneconomical, and a comparatively large amount of fuel is required to furnish steam to run the pump. The water works system is owned by a private company, which also owns a natural gas well in the same locality. The company desire to install a more economical pump and, if possible, to avoid the necessity of the two coal-fired boilers. Mr. Chas. A. Hague, consulting engineer, of New York City, was retained to advise the best type of pump adapted to the operating conditions. Although these conditions are similar to those presented at many points along the Ohio and other rivers in the Central States where the water level is subject to wide variation, the head to be pumped against is excessive for such a small system. It was also desired to at least balance the interest on the investment for a new pump against the saving in coal, and to utilize as fully as possible the gas-fired boilers and the present pumping station. Mr. Hague has designed and is installing a pump which has a number of particularly interesting features and will involve a relatively nominal expenditure. It consists of four water chambers placed in the bottom of the pit, and two large vertical plungers, with the necessary plunger barrels and suction and discharge connections. The plungers are driven by a sheave wheel of a rope drive at the floor level of the station building over the pit.





Plans and Elevations of Catlettsburg, Ky., Water Works Pump.

A bottom of concrete, 3 ft. thick, has been laid in the pump pit to form a setting for a heavy cast-iron bed plate on which the pump will be erected. The four water chambers will be placed 90 degrees apart on the circumference of a circle concentric with the bottom of the pit, and will be operated in pairs by the two vertical plungers. These plungers extend nearly to the top of the pit, where they are each connected by a crosshead and connecting rod to the crank disks of the sheave wheel of the rope drive. The rope drive will be run by a 250-h.p., 24 x 48-in., horizontal Corliss engine in the pumping station, the sheave wheel at the top of the pit and the one direct-connected to the engine being 20 ft. on centers.

A 24-in. horizontal suction pipe enters the bottom of the pump pit at one side and extends diametrically across it, and is blanked at the other side. Two of the water chambers are placed on each side of this pipe and are operated as a pair by one of the plungers, the barrel of which is placed between them as shown in the accompanying illustration. One chamber of each pair is connected at one end and the other at the other end of the portion of the suction pipe within the pit. Water will thus be drawn from both ends of that part of the suction at the same time, so a pipe large enough to insure an adequate supply to the chamber at the dead end has been included. A vertical 24-in. tee connection is made with the suction at the center of the pit and carried up 6 ft., where it is blanked to form a vacuum chamber for the pump.

Valves are arranged so each water chamber may be cut off from its plunger barrel and from its suction and discharge connections, without interfering with the operation of the other three. This makes it possible to continue the operation of the pump uninteruptedly while one, or more of the chambers is out of service for cleaning or repairs. The pump is thus particularly adapted to handle water carrying a large amount of sediment.

The suction connection of each of the water chambers is on the side and the discharge at the top. The vertical discharge pipes of the four chambers are connected to a 20-in. vertical central discharge, resting directly on the blanked end of the vacuum chamber. To avoid the weak, four-way special connection which would be required if these discharge pipes were connected to the central discharge at the same level, one discharge of each pair of water chambers is connected at one level and those of the other two, 3 ft. above them.

The discharge from the two water chambers which are served by the same plunger will occur simultaneously, but this arrangement of their discharge pipes lessens the possibility of the formation of eddies in the central discharge. The same patterns may be used in making both two-way pipe specials, and the only extra pipe required in making the connections of two of the discharges above those of the other two is a 3-ft. piece of straight pipe.

The 14-in. riser main leading to the reservoir is connected to the central discharge just above the two upper connections of the discharge of the pump chambers with the latter, and 16 ft. above the floor of the pit. The 20-in. central discharge is extended 16.5 ft. above the riser main connection and blanked at the top, forming a large air chamber for the pump.

The length of the plungers from their bottom ends to the connection with their cross-heads at the top is 30 ft. They are to be built of heavy flanged, cast-iron pipe sections and will be loaded until the weight of each of them, including their cross-heads, connecting rods and all moving parts, equals half the water column.

The walls of the pump pit being 1 ft. thick and of rather uncertain character, it was considered undesirable to break through them, owing to the difficulty of making the openings watertight again. For that reason it was necessary to support the guides for the cross-heads of the heavy vertical plungers from the bottom of the pit. Two brackets are cast on the top of each of the plunger barrels and a cast-iron column set on each bracket and carried up to within 5 ft. of the top of the pit. The four columns are thus arranged in two pairs, each pair carrying the guides of the cross-head to which one of the plungers is attached. The columns are divided in three nearly equal lengths. At the two intermediate joints between these lengths horizontal brackets are inserted and braces extended to the central discharge main and air chamber to steady it.

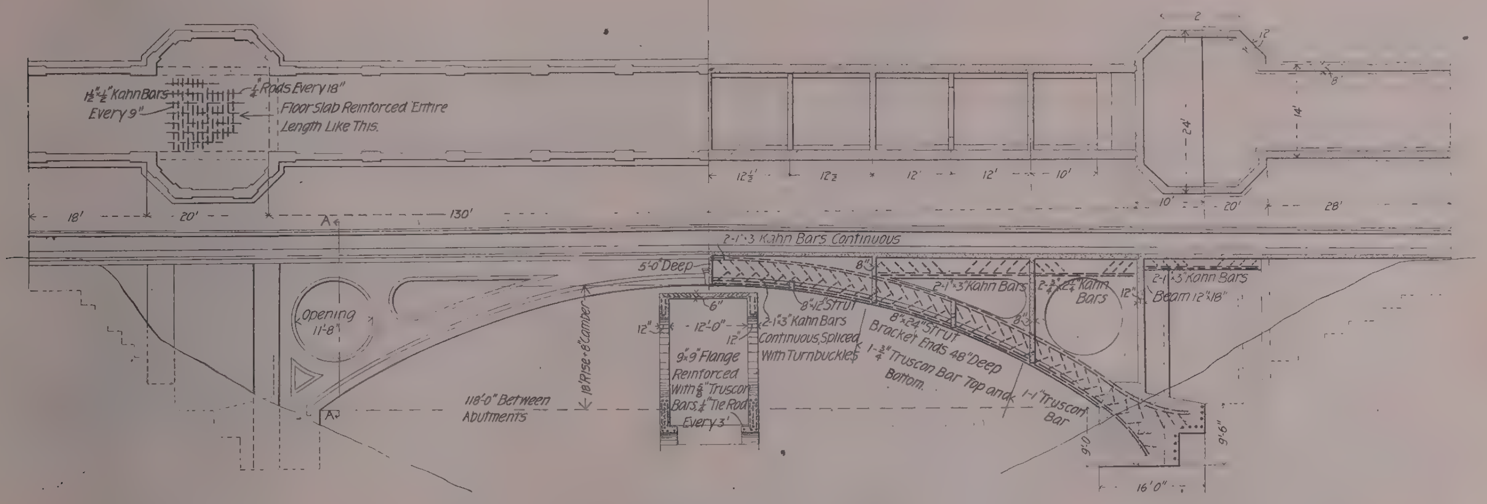
The travel of each plunger is 3 ft. Its connecting rod is 14 ft. 10 in. long and is attached at the top to a crank disk on the axle of the sheave wheel of the rope drive. This sheave wheel has a 5-ft. face, is 13.5 ft. in diameter and will be carried by an outboard bearing on each side. It weighs 30,000 lb. and has been designed to produce sufficient fly-wheel action to insure steady running. The weight of the wheel and its bearings, as well as the thrusts developed when the pump and wheel are in operation have to be carried on the bottom of the pit and on a curbing around the top of the pit, independent of the side walls, the total weight being about 100 tons. The same four columns that carry the cross-head guides will carry the part of the load and the thrusts that will be transmitted to the floor of the pit.

The distribution of these loads and thrusts in lines which would be in the vertical planes of the pairs of columns was difficult to obtain, but has been successfully accomplished. Part of the loads and thrusts is carried by three longitudinal 24-in. I-beams, 21 ft. long, under the base of each bearing. The ends of these beams rest on a solid concrete curb laid around the top of the well. The three beams on each side are supported at the center by a heavy cast-iron box pedestal, the pedestal resting on two pairs of 24-in. transverse I-beams, carried at the ends by the columns. The bases of the bearings are anchored to the pedestals by bolts between the longitudinal beams. The upper flanges of the transverse I-beams are placed in shallow depressions cast in the bottom of the pedestals. Two bolts extend from the transverse top of the pedestal on each side down between the transverse I-beams and through head-plates cast on the columns. The lower I-beams are also anchored to each column by a cap plate and two bolts. The rigidity of the supporting structure at the top of the pit is thus believed to be reassured by the manner in which it is assembled and the loads and thrusts distributed on it.

The horizontal thrust produced by the rope drive will be counteracted by bracing the concrete curb around the top of the pump pit, on which the longitudinal I-beams directly under the bases of the out-board bearings are placed, against the setting of the engine running the drive. The engine setting will be of concrete and two concrete buttresses are extended from it to the curb. The horizontal thrusts of the sheave wheel over the pump pit and the one at the engine will thus be counter-balanced, as the English multiple-drive system, without any compensating device, has been adopted.

The pump is designed for a capacity of 3,000,000 gal. per 24 hr. when operating at 30 r.p.m. Its capacity may be easily increased to 6,000,000 gal. by making a few changes in the plungers and their stuffing boxes, and then increasing the speed to 35 r.p.m. A thick bronze liner, which may be removed, has been provided in each plunger casing. When this is taken out and a new liner of larger diameter and less thickness substituted for it, and new glands provided, the plungers may be increased from 17¼ in. to 22¼ in. in diameter. The doubling of the capacity of the pump would require the engine capacity to be increased to 500 h.p.

Although the pump is believed to be specially adapted to the conditions for which it has been designed, studies have been carried out for a triplex pump built on the same lines, which would be an even better installation. The local limitations of space and other requirements, however, precluded the adoption of the latter type. The engine of the rope drive will be placed in a room partitioned off in the present boiler room, thus avoiding an addition to the station building.


1½"·½" Kahn Bars Every 9"
¼" Rods Every 18"
Floor Slab Reinforced Entire Length Like This.
18'
20'
130'
A
12½'
12½
12'
12'
10'
2
12
8'
24'
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2-1"·3 Kahn Bars Continuous
5'-0" Deep
Opening 11'-8"
18' Rise + 8" Camber
118'-0" Between Abutments
6"
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12"
9"×9" Flange Reinforced With ⅝" Truscon Bars, ¼" Tie Rod Every 3'
2-1"·3" Kahn Bars Continuous, Spliced With Turnbuckles
8"×12" Strut
8"
8"×24" Strut
Bracket Ends 48" Deep
1-¾" Truscon Bar Top and Bottom.
2-1"·3" Kahn Bars
8"
2-¾"×2¼" Kahn Bars
12"
2-1"·3" Kahn Bars
Beam 12"×18"
1-1" Truscon Bar
9'0
9'6"
16'0"

Plan and Elevation of Reinforced Concrete Bridge at Lake Park.

The Reinforced Concrete Bridge at Lake Park, Milwaukee.

The new reinforced concrete foot bridge at Lake Park, Milwaukee, occupies a commanding position parallel to the shore of Lake Michigan and about 150 yards from it. The ravine, about 50 ft. deep, which is spanned by this structure, runs back from the lake to a point about 25 yards above the bridge site, where it is formed by the junction of two ravines of somewhat less depth. Comprehensive plans for Milwaukee's park system include a roadway down the ravine to the lake shore and thence south on the beach with a driveway. It was at one time planned to build a Y-shaped bridge at the junction point of the several ravines, consisting of three steel spans meeting and resting upon a center trestle tower. Such a plan could have been modified to the use of three concrete arches thrusting against a central abutment, which would have been a decided novelty in construction, in addition to serving as a threefold means of communication across the ravines. It was, however, finally decided to build a single structure across the lower ravine. The specifications of the Park Board covered the general style of architecture, and called for a ribbed arch span.

In accordance with these general specifications the design was prepared by the contractor, and the contract let after some slight modifications had been made with reference to the architecture. The approaches consist of a reinforced floor supported on concrete walls. Imbedded in these walls every 12 in. are ¼-in. bars to prevent injurious frost action. The span of 118 ft. is treated as an arch fixed at the abutments and carrying a live load of 80 lb. per square foot in addition to its own weight. The computations of stresses were made in accordance with the method of the late Prof. C. E. Greene in his treatise on "Arches." On account of the bearing value of the earth against the proposed abutments being rather an uncertain quantity, and as the correctness of the design depended upon the fixedness of the abutments, it was considered advisable by the contractor to use a low allowable pressure, and so one ton per square foot was assumed. In order to keep the abutments down to a reasonable size and still have this low bearing value, it was desirable to be as economical as possible with the dead weight of the arch superstructure, at the same time being consistent with the requirements for strength. The ribbed arch proved itself admirably adapted to such conditions.

The span has two reinforced ribbed arches of 54 x 12-in. section with a 9 x 9-in. inside bottom flange added for architectural effect. The arches are braced together at intervals of about 12 ft. with cross-walls or struts and are built up to carry the reinforced floor slab, being reinforced over the ornamental openings to form girders. The reinforcement in each arch consists of four 1 x 3-in. Kahn bars, made continuous by splicing with turnbuckles spaced about every 30 ft. Some additional reinforcement was used as shown in the design, and the flange was tied to the arch rib with ¼-in. rods of soft steel hooked to the main bars in the arch rib and flange. In the floor slab the reinforcement consists of ½ x 1½-in. Kahn bars spaced 9 in. center to center, with ¼-in. bars running longitudinally every 18 in. and some larger bars placed diagonally, making a sort of lateral system.

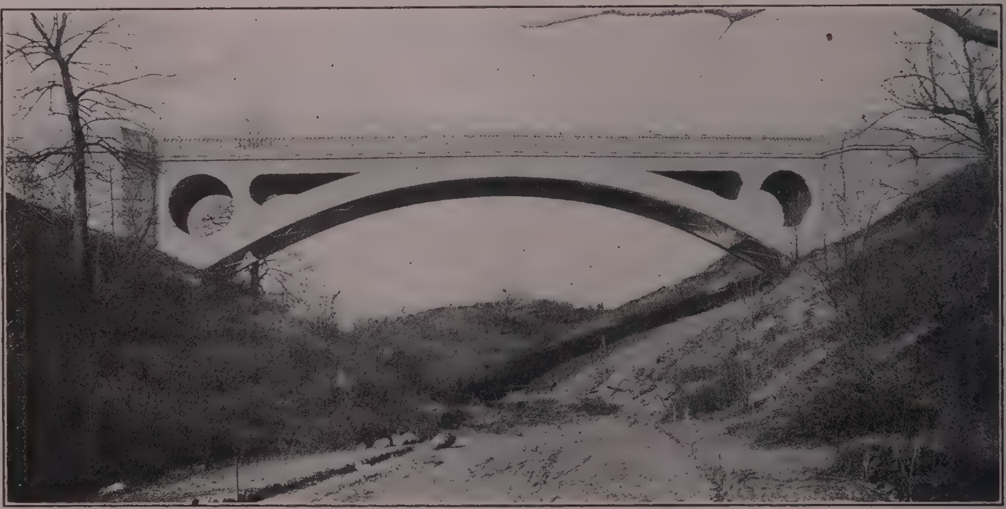
In making the surveys to locate the abutments, extreme care was taken to insure accuracy. The result of this became apparent after the completion of the work. The distance between faces of abutments is correct to within 0.01 ft.

The surface of the sloping sides of the ravine showed a decided tendency to slide after every rain, so, in erecting the falsework for the span, excavations were made down to good clay, and reinforced concrete footings spread under each post. The falsework was built in general as follows: posts, 6 x 8 in.; cross-struts, 6 x 6 in.; caps, 6x6 in. or 6x8 in.; diagonal bracing, 2 x 6 in., and longitudinal struts, 2 x 8 in. The weight of each arch rib or wall was carried on a double line of 3 x 12-in. stringers, resting on wedges. Between the walls were two lines of 2 x 12-in. stringers. All the stringers were fitted with curve strips, and across the tops a platform of 1-in. rough lumber was built. From this platform the forms for the superstructures extended upward. In general, all wall forms were made of 1-in. boards, dressed and matched if for exposed surfaces, supported on 2 x 6-in. studs. These studs were wired together at frequent intervals. For erection purposes a bottom lateral system of 2 x 2 x ¼-in. angle irons was used, and this has been left in place permanently.

The posts for the balustrade were cast in place, and then the sections of the base of rail between them. The balusters were cast in a cast-iron mold, cured, set up in place, and then the hand-rail cast in place.

In removing the falsework, the wedges were loosened gradually, starting at the center and working towards the abutments. The maximum deflection at the center of the span, after removal of false-work was found to be about 5/16 of an inch.

Prof. F. E. Turneaure, of Madison, was retained as consulting engineer by the Park Board to examine and report on the plans submitted by the contractor. The Newton Engineering Co., of Milwaukee, made the structural design and all details and, as contractor, constructed the bridge in its entirety; acting for the contracting company on the work were Ralph E. Newton, president and chief engineer; Alfred L. Newton, secretary-treasurer; and George C. Newton, foreman of construction. Lehigh Portland cement was used throughout. All reinforcement was according to the Kahn system, and was furnished by the Trussed Concrete Steel Co., of Detroit.



Elevation of Completed Bridge at Lake Park.

A Three-Phase Railway 43.8 miles long is under construction from Vienna to Pressburg, which will be operated within the city limits by direct current. It will be used for both freight and passenger service. In Vienna the municipal electric station will furnish the direct current while a station at the center of the line will furnish three-phase current. Motor cars will be used for passengers and electric locomotives for freight.

Notes on Railway Construction in North China.

According to an interesting paper by Messrs. E. H. Rigby and W. O. Leitch on railway construction in North China, recently published by the Institution of Civil Engineers, Chinese maps partake more or less of the nature of a pictorial sketch, sometimes giving a fair idea of the district, but no measurements can be taken from them and they are of little use for railway work. The chief difficulty in making a survey is to avoid graves, which are scattered about everywhere, instead of being collected in cemeteries. The burying-grounds of wealthy people practically cannot be touched; graves belonging to poor people were avoided if possible; but where it was necessary to remove them a money compensation was arranged and the coffins were interred at another place. Another difficulty is to ascertain flood-levels, and to estimate the effect of the embankment on floods. The river-channels, in general, have gradually become silted up, and after a heavy rainfall the adjacent plains are inundated.

As soon as the location, pegging out, and leveling of the center-line of the road on which the authors were engaged were completed, the side widths were calculated and a list of them was given to the Chinese official appointed to buy land and to pay compensation for removal of graves. Land-buying in China is an art, requiring the services of an expert. Many of the plots are small and crooked in shape, the boundaries between adjacent plots being difficult to trace. The result is that the railway land boundary is far from straight.

After the railway was completed, stones were put in to mark the boundaries and a survey of them was made. Special surveys were made, to a larger scale, of all land near stations; this is the only land which increases much in value after the railway is built, and it is quickly encroached upon by neighboring land-owners if not carefully looked after. A large area was bought for each station site, and parts not immediately required were rented out. The average price of land was £5 17s. per acre, and compensation was paid for removal of graves at an average rate of 8s. 9d. each, most graves containing only one coffin.

The earthwork for the whole line was let to a Chinese contractor who had done a large amount of similar work on lines previously constructed. He was supplied with a list of the heights of embankment or depths of cutting at each peg, and was told the width of formation and the inclination of slopes required. He employed several thousand coolies, who lived in huts of mats stretched over bamboo half-hoops. Each man has a shovel, and two baskets carried at either end of a shoulder-pole; an alternate method, rarely used for contract work, is by means of a large basket carried on a shoulder-pole by two men. The embankments were all made from side-cuts, and the spoil from cuttings was heaped up in mounds on either side. The height of the highest embankment is 35 ft., and the depth of the deepest cutting is 20 ft. The earthwork was paid for at 1.1 to 1.7d. per cubic yard. The contractor found all his own tools, etc., but paid nothing for rent of engine, cars, etc., which would probably add another 0.8d. per cubic yard to the price of the filling by train haulage. Several cuttings through rock of varying hardness were let to different contractors at an average price of about 9d. per cubic yard. Gunpowder, drill steel, etc., were supplied to these men at cost price, and any surplus on completion of the contract was paid for at the engineer's valuation, which was rarely disputed. The Chinese are excellent at earth-work, but not so good at rock-cutting. They drill only small holes, and use very small charges of explosive.

The ballast was specified to be broken to pass through a 4-in. ring, but a fair percentage of it was considerably larger, in spite of the contractors being fined and made to send men out on the line to break it. The sub-contract price for the ballast, loaded into cars, was between 6½ and 9d. per cubic yard, the price varying at different quarries.

For purposes of rail-laying, a portable track of 2 ft. gauge, ¾ mile in length, was laid along the edge of the formation. The rear end of this track overlapped the rail-head train, and all materials were unloaded on to the 2-ft. gauge trolleys, pushed forward, and spread out by coolies, who left everything ready for the spiking and bolting gang. Another gang following straightened and packed the track, so that trains could be run to the rail-head a few hours after the track was laid. Owing to the length of the dry season, a very good track can be kept without ballast, and no temporary or service roads were used to distribute the materials. A day's work in track-laying was ½ to ¾ mile, including deviations round bridges and sleeper-stack temporary bridges where required. The work was done partly by contract at a cost of 1.4d. per lineal yard, including the cost of the trolley-track, unloading materials, carrying them forward, laying, spiking, and bolting the track, and packing and straightening it sufficiently for a train to be run over it without damage to the rails. No charge was made for tools supplied to the contractor. The ballasting was done by special ballast-trains of twenty to twenty-five cars, holding about 17 cu. yd.

each. These cars were unloaded through side doors by means of shovels. The track was lifted in two lifts, and after it had been well packed and straightened the top-ballast was spread. The rough packing was done by contract, the price paid for unloading the ballast, lifting the track 8 in., and leaving it well packed and straightened, was 1.6d. per lineal yard. This contractor was followed by a gang of men paid by time, who thoroughly packed and straightened the road, making it ready at once to receive trains running at 20 miles an hour.

With a few exceptions, where the ground was hard and not liable to be scoured out by floods, all bridges were founded on piles 16 to 24 ft. in length. The heads of these piles are embedded 6 to 9 in. in the concrete foundation-block. The spans are of the standard lengths adopted on the Imperial Chinese Railways, viz., 10, 12, 20, 30, 60, 100 and 200 ft. The girders are all of the Imperial Chinese Ry. standard, and are of the deck-type, with the exception of a 200-ft. span of the through-type. The bridges are decked with Oregon-pine timbers, 10 ft. by 9x8 in., spaced 20 in. apart, center to center, notched and bolted to the upper flanges of the girders. Guard-rails of Oregon pine, 6x6 in., are notched and bolted to these ties.

Most of the river channels are too small to carry off the flood-waters, and many of the bridges are intended as flood openings to take the water which spills over their banks. Where there is a regular channel, training-banks have been built out from the line to direct the water through the bridge and to prevent eddies round the piers as much as possible. At flood openings, where water often comes from all directions and largely along the railway-bank, these training-banks leave the railway-bank gradually and are well rounded off at their ends. This counteracts the tendency of the water to cut through the training-bank close to the bridge. Where the flow of water is strong, aprons of rough pitching have been laid to prevent scour under the piers, but as all the bridges, where the ground is soft, are founded on piles, there may be considerable scour without risk of damage to the bridge. Drains and culverts are built of concrete or of large granite slabs. At one or two places where the headway was small, old rails were embedded in the concrete of the roof, or a deck was constructed of old boiler plates and rails riveted together, covered with 6 in. thickness of concrete and well tarred on the lower side, which was exposed to the water. All concrete was mixed by hand, the Chinese coolies trained to this work being very expert at it. Several piers between Tientsin and Peking were partly blown up by the Boxer rebels, and the material proved to be excellent. The finely ground Alsen cements were invariably used for the more important works.

The range of temperature in North China being ing about 120° F., ample provision has to be made for expansion in bridges. The bearing-plates of all girders up to 30 ft. span rest on 6-in. Oregon pile wall plates, well tarred and secured to the tops of the piers. The 60-ft. spans are provided with plain sliding plates, well bedded and secured to the tops of the piers. All girders exceeding this length have roller bearings. It is inadvisable to use sheet-lead under girder bearings in China, as it would be quickly melted out and stolen.

The total cost of the air plant, used at the bridge piers, divided by the number of cubic feet of caissons sunk by its means, and allowing 75 per cent. for depreciation, interest, and general overhaul, but not including minor repairs while in use, averages 1.2 d. per cubic foot. This rate has been taken as the rent of the plant in estimating the cost of bridges. The Chinese have not yet been required to work under air pressures greater than 30 lb. per square inch, but so far as they have been tried they have proved admirably adapted for working in compressed air, and fortunately it is unnecessary to make them conform to the very strict rules which are imperative for Europeans. A set of such rules is given to the gangers, but with limited supervision it is quite impossible to see that they are obeyed. Notwithstanding this, during the last 10 years there have been only two cases of men being overcome.

The total rainfall in North China for one year is small, but practically the whole of it occurs in July and August. In 1903, July was a comparatively dry month, but August was very wet, and on August 28 all the large rivers were roaring torrents and most of them overflowed their banks and flooded the country on either side. At several bridges the water was nearly up to the girders, but, except at one bridge no damage was done to the permanent work. The damaged bridge is in the center of ground lying below the level of the Ta Ling Ho. The embankment is about 10 ft. in height, and the water rose to the top of it, but fortunately the ends of the bridge (a single 20-ft. span) were washed out, and relief was thus obtained before the flood rose higher. The gap thus made was 150 ft. in length, and the bottom was scoured out to a depth of 20 ft. A section along this gap gives an area of twenty times that provided by the bridge. The abutments are founded on 24-ft. piles, which, with only 4 ft. of their length remaining in the bottom, kept the bridge in perfect line and level.

As this was the largest flood ever known to have occurred on the Ta Ling Ho, it did not appear justifiable to go to the expense of increasing the opening, and the gap has therefore been filled in, the ends being pitched to confine any future break. The flood at this point lasted only 12 hours. On the plains there was considerable danger from the wind which accompanied the rain. Whenever the waters attained a depth of 2 or 3 ft. and no crops were standing, the waves cut into the soft earth of the bank so much that it was only by throwing down the track-ballast that damage to the bank was stopped. Stone has now been placed on the slopes to protect them from waves, wherever, owing to marshy or salt ground, crops are not grown. The almost universal crop of millet, the stalks of which reach a height of 10 to 12 ft., prevents the formation of waves. The water drained off in two days to a safe level, and in three or four days had almost disappeared, with the exception of pools.

At one place there is a river which, starting from the hills, traverses the plain for a distance of 15 miles, gradually widening out to 500 ft. in width and about 8 ft. in depth. In the dry season the quantity of water flowing is very small. In a distance of two miles the river course gradually contracts to about 15 ft. in width, and when the floods come the water overflows all along this length and runs over the plain to the sea. In the vicinity of this and other overflowing rivers, after a heavy rainfall, mud and silt are deposited on the fields to a depth of 2 to 6 in., and, assuming that a serious flood occurs every five years, the surface is rising in places at the rate of ½ in. per annum. Trees have the appearance of being covered up, and houses which, in the lifetime of old men now living, were built 2 ft. above the ground, are now level with the surface. A pit was sunk at one of these places, and layers deposited by successive floods, and even plough-marks, were distinctly seen.

At one place the railway passes through a gap in the hills, which is also occupied by the Hsiao Ling Ho River. The river comes right up to the edge of the hill slope, by which its course is bent round through an angle of nearly 90 deg. In winter the channel is small, leaving the greater part of the bed dry, but after heavy rain the water rises 12 ft. and extends to a width of 2,000

Views of the Lake Park Bridge in Milwaukee During Erection.

ft. Following the contour of the hill, so as to keep out of the river-bed, would have involved reverse-curves of 1,500 ft. radius, in heavy rock-cuttings, and a tunnel 800 ft. in length. Besides introducing sharp curves in an otherwise easy line this would have been expensive, and it was therefore decided to run the railway straight on across the bend of the river, with heavy pitching on the embankment. The river bank and railway stand in relation to each other approximately as an arc of a circle to the chord; the total length of the protected bank is 5,000 ft., and the greatest width of the encroachment on the river is 300 ft. The embankment was made 21 ft. in height, with a 1-to-1½ slope on the inside and a 2-to-1 slope on the river side, broken by a bench for the tramway for conveying materials, etc. The earthwork was done in the spring of 1900. The apron, 30 ft. in width and 3 ft. in thickness, was started in the winter of 1899-1900. Quarries were opened in the face of the hill, and sidings were laid along the apron. Large rough stones weighing about 1 ton were used, placed close together, the spaces between them being filled with smaller stones. The larger stones, some of which weigh 2 tons, were placed along the toe. As the bank was completed the pitching of the slope was laid in the same manner as for the apron, but of lighter stones, and was carried up to 13 ft. above the river bottom. This part of the work was completed in June, 1900, in time for the rainy season. In 1903, when work was resumed, the pitching was continued up to formation level. In the floods of 1903 the water was 12 ft. in depth, but no damage was done to any part of the work. The apron was scoured out a little, but so far it has not sunk more than 3 ft. In future floods it may gradually sink down to about 10 ft., which is about the limit of scour at the side of the river. Then it will remain a permanent protection to the bank. Any gaps that may occur in the process of sinking will be filled by the reserve of stone on the top slope. To let out the water from the cut-off bend of the river an 8-ft. arch culvert has been made, of concrete on piles; the wing walls on the river side curve downstream, and specially heavy pitching is placed in the line of the culvert.

East of one of the stations, where the railway bank is low, the track has been lowered to the ground level for a length of 500 ft., at the end of which it resumes the ordinary formation level. Pitching has been placed along both sides of the track, and in years of exceptional floods the water will flow over the track to a depth of about 1 ft. There are several of these sunk tracks on the system. In years of great floods, when ordinary channels overflow, a considerable quantity of water is inevitably held up by the railway bank, in spite of the numerous bridges. No harm may result to the railways, but the villages near may suffer. These sunk tracks have been provided to let the water out; their cost is only a fraction of that of a bridge, which might have to be 1,000 ft. or 2,000 ft. in length to fulfil the same duty. The worst harm the water can do is to put out the engine fires; this requires a depth of water of 18 in. above rail level, which never occurs for more than a few hours per annum, on the average, when the stations are probably cut off from the roads, and few people are traveling. Sand or mud deposited on the rails is soon cleared off.

The Deterioration of Coal in the open storage yard of the Boston Edison Electric Illuminating Co. is stated by Mr. Charles H. Parker to be 6.5 per cent. Taking into consideration the fact that the coal contains 2.2 per cent. more moisture in winter than in summer, owing to the amount of snow and ice that is brought into the station with it, the net loss by weathering is placed at 4.3 per cent.

Book Notes.

The volume on "Electric Traction," written by Prof. Robert H. Smith, and published by the London house of Harper & Bros., at 9s., is rather disappointing to American readers. The author confines his text to European practice, and even then fails to be entirely just to certain parts of his subject. For example, in the section on surface contact systems, in which about half a dozen systems are described, the only two which are successful are not explained and one of them is condemned. The book's chief value is its detailed information about the Glasgow trolley lines, the Central London Underground Ry., the Metropolitan and Metropolitan lines of London, the Elberfeld monorail road and three-phase lines. The book is lacking in perspective, and is simply a statement of the author's views concerning various electric railway topics.

A good indication of the way in which technical colleges are following the new practice in railway surveying is shown by Prof. J. C. L. Fish's pamphlet on the "Mathematics of the Paper Location of a Railroad." This pamphlet explains a method of computing from a paper location alignment notes by which to run in a field location. This practice is now followed on many railroads, and the old custom of sealing from the plotted line is generally employed only as a check. Very little has ever been printed on the subject, although it is well known among locating engineers, and the fact that it is taught in technical schools shows that the latter are kept in closer touch with field practice than might be believed from a casual examination of text-books on railway location. (New York, M. C. Clark, 25 cents.)

A 500-page book of information relative to shipments to all countries has recently been published under the title of "Exporters' Encyclopædia." It gives information concerning the shipping lines from various American ports, general suggestions concerning the methods of making shipments and securing papers for such transactions, an explanation of the documents to be secured from the consuls of countries to which the shipments are made, and directions for packing, marking, insuring, consigning and otherwise transacting export business. Now that American manufacturers are paying more attention to their foreign trade the value of such a volume as this, which is revised annually, is too evident to need comment. (New York, 65 Duane St., Exporters' Encyclopædia Co., cloth, $3.00.)

The studies which Mr. Olaf Linders has been making for a number of years concerning the relations between physical units have resulted in the publication of several monographs, the last being his "Klarstellung der Begriffe Masse, Gewicht Schwere und Kraft." The relations between the various physical units are often hard to grasp, and the rapid development of the field of electricity has added to the confusion. This has caused a decided inconvenience, and there have been numerous attempts to clarify the condtions. The purpose of this pamplet is to explain the relations between some of the units used in science and engineering, particularly those relating to mass, weight and force, and will be found an interesting statement of the causes that have led to the present confusion. (Leipzig, Jäh & Schunke, paper, 1 mark.)

The Office of Experiment Stations of the Department of Agriculture has issued a very interesting monograph on "Water Rights on Interstate Streams," by Messrs. R. P. Teele and Elwood Mead. It is essentially a discussion of the conditions that have arisen on the Platte river and its tributaries. The investigation brings out five different points: (1), The rights as established, if measured by the original use, are for excessive amounts of water. (2), This tends to augment the value of early rights to the injury of later ones. (3), The separation of rights from the place of original use renders it difficult to correct excessive decrees. (4), The rights on some tributaries approach more nearly actual original uses than they do on others, hence a tabulation of the appropriations now vested in accordance with their priorities would not serve as an impartial standard for the division of water between States. (5), The limitations on property rights in the water of the river should be brought into an agreement, as a preliminary step to the division of water across State lines. The pamphlet contains a discussion of return seepage from irrigated lands, and its effect on stream flow.

The well-known text-book on "Structural Mechanics," by the late Charles E. Greene, has been revised by Professor A. E. Greene. The original edition was reviewed at some length in these pages when it appeared, and its many merits were pointed out. While the book has had a wide circulation since then, this has not been so extensive as it deserved, owing to the fact that the author was his own publisher and did not have the facilities for handling its sale which a regular publishing house possesses. In its revised form little change has been made in the text except in a slight rearrangement of the chapters, and the rewriting of a few sections of most of them, together with the addition of a chapter on reinforced concrete. Nothing has been done, however, which detracts from the clearness of the original text, which was remarkable even in this day of excellent text-books. The book is an excellent statement of the principles underlying the structural work of the civil engineer. (New York, John Wiley & Sons; cloth, $2.50 net.)

Machine Design. By Albert W. Smith and Guido H. Marx, New York, John Wiley & Sons; cloth, 8vo, 377 pp., $3.00.

This interesting text-book is wholly unlike most of the works on the subject, in that it has no picture of a completed machine and there is no explanation of the design of an entire machine. It is an explanation of principles, rather than their wholesale application, and is intended to emphasize the prime importance of adaptation, strength and stiffness, economy and appearance in designing machines. The sub-divisions of the subject in the order in which they are taken up are as follows: Motion in mechanism, parallel or straight-line motion, cams, energy in machines, proportions of machine parts as dictated by stress, riveted joints, bolts and screws, means for preventing relative rotation, sliding surfaces, shafts and spindles, bearings and lubrication, roller and ball bearings, couplings and clutches, belts, flywheels, toothed wheels or gears, springs, machine supports, and machine frames.

The authors frequently repeat the caution they give in the introduction to the book, where they say: "In proportioning machine parts the designer must always be sure that the stress which is the basis of the calculation or the estimate is the maximum possible stress; otherwise the part will be incorrectly proportioned. For instance, if the arms of a pulley were to be designed solely on the assumption that they endure only the stress due to the belt tension, they would be found to be absurdly small, because the stresses resulting from the shrinkage of the casting in cooling are often far greater than those due to the belt pull." It is also pointed out that the design of machinery by experiment is slow and expensive; if any part had originally an excess of material, it is not changed, for only the parts that yield are perfected.

The subjects themselves are so thoroughly well known that there is practically nothing new to be said about them, save in a few chapters. The novelty of the book is to be sought in the way the subjects are discussed, which is marked by unusual clearness and references to important papers on the topics which deserve more attention than can be given them in a volume of this size.

Modern Turbine Practice and Water Power Plants. By John Wolf Thurso. New York, D. Van Nostrand Co.; cloth, 8vo., 266 pp., $4.00 net.

The lack of any practical American book on turbines has long been deplored by engineers. Prof. Wood's book is too theoretical and the information on wheels in Mr. Frizell's "Water Power" is not sufficiently detailed to do the subject the justice it demands. Probably one reason for this is the fact that there have been very few American designers of turbines who have paid much attention to the scientific theory of turbine operation, and another reason is the American preference for manufacturing turbines to standard sizes rather than for designing wheels for each installation. In Germany and Switzerland, where the latter practice has been followed, there has been a marked development of the theory of these prime movers and many careful tests of such machinery under working conditions have yielded information of great value in checking theory and making it applicable in practical design. Consequently nobody can write a satisfactory book who is not familiar with both European and American practice, knowledge that is possessed by the author of this work, who has designed turbines in America and Europe and been connected with hydraulic power plants aggregating nearly 200,000 h.p.

The book is in two parts, the first and larger part being devoted to modern turbine practice. The development of turbines in Europe is first described and then the development in America. The classification of wheels is next explained, the author being an advocate of the reaction-action-limit sub-division. The chapter on modern turbine types is the most useful in the book. Turbine construction in general is first explained, and then the design of low, medium and high head wheels by leading manufacturers is described in considerable detail. The manufacture of turbines is also sketched in this chapter. The accessories of turbines, draft-tubes, valves, throttling gates and gauges, have a chapter to themselves, and the same is true of governors and speed regulation. In connection with the last subject the Am. Inst. E. E. paper by Mr. Allan V. Garratt on the elements of design favorable to speed regulation in plants driven by water power, is printed in an appendix.

The second part of the book is on water power plants. The first chapter explains the principles on which head-races, tail-races, water-racks, head-gates and penstocks should be laid out. The second chapter is on the steps to be taken in the development of water powers, the character and effects of surface and anchor ice, the measurement of water for selling water-power, and the cost of water power. This part closes with tables of American and metric measures.

The author's own statement of the contents of the book is a fair one, "the object is to give such information in regard to modern turbines and their proper installation as is necessary to the hydraulic engineer in designing a water-power plant, and no attempt has been made to treat of the design of turbines, as to do this satisfactorily would require in itself a very large volume." This aim has been well carried out, except for the intrusion of a chapter on the steam turbine, and the volume is a good explanation of the field outlined above. It contains some statements concerning the character of American wheels which are incorrect and many that are not rated as high by the author as by some eminent European critics, while there are some competent American hydraulic engineers who will not agree with the high respect the author apparently shows to certain European installations. If the book draws attention to the good features of practice everywhere, which it certainly does, we can afford to overlook the rather tactless criticisms of some of our favorite ideas. There is one point brought out by the author that should receive careful attention by designers of American power plants. While the turbine is the most important element of a development, its cost is comparatively small, rarely exceeding ten per cent. of the total, and the increase for a really high-class wheel, designed for the site, would be hardly noticeable in the whole cost of the power plant. The hydraulic engineer should not be compelled in important work to prepare his plans to suit standard turbine patterns, but should be free to call for that turbine which is best adapted for the given head, water volume, and speed conditions, whether it is a standard pattern or not.

Letters to the Editor.

Sulphate of Copper Tests at Denver.

Sir: We are enclosing herewith data giving the results of two tests which the Denver Union Water Co. has made during the past season in the application of copper sulphate to water for the purpose of eliminating the unpleasant effects due to the presence of algæ. The results obtained in the treatment of our Marston Lake reservoir are of especial interest because of the large body of water treated and of the satisfactory results which were obtained, and we trust may be of interest and use to some of your readers.

Launch Rigged with Sulphate Bags.

Before the treatment with copper sulphate the lake had a bluish-green appearance, but no surface scum was observed. The bacteriological count was about 700 bacteria per c. c. Other organisms than Anabæna were present in considerable amounts. Of the diatoms, there were about 600 standard units of Synedra. Several other diatoms were present in small numbers, viz.: Asterionella, Cyclotella, Navicula, and Stepanodiscus. A few of the smaller forms of Chlorophyseæ were present, viz.: Closterium, Eudorina, Pediastrum, and Staurastrum. Of the Protozoa,—Ceratium and Peridinium were present. Also a few Crustaceæ were observed.

The copper had an immediate effect on most of the organisms. Samples were taken while the water was being treated and every 24 hours afterwards for five days. The sample taken 24 hours after treatment showed no Anabæna whatever. Synedra had been reduced to 90 standard units. The Protozoa were all dead and the Crustaceæ were very sluggish. The bacteria were reduced to 255 per c. c. The smaller diatoms seemed to be more numerous, probably due to the fact that the copper had killed them and that they were floating near the surface. Forty-eight hours after treatment the bacteria had multiplied very rapidly on the food furnished by the dead organisms. No Protozoa were found and the Chlorophyceæ were disappearing. Ninety-six hours after treatment only two or three species were left and these were apparently dead.

On the fifth day the bacteriological count had increased to 107,500 per c. c. and practically no organisms were to be found. The lake had the characteristic steel-blue appearance. Another sample was taken nine days after treatment and no organisms were present.

An examination was made of the inlet water coming into the lake to determine whether or not Anabanæ might be present in that. The results showed no trace of Anabanæ. The only species were a few diatoms.

Tests were made for copper in 1,000 c.c. of the sample taken 96 hours after treatment and the reaction was negative. The delicate potassium ferrocyanide test was used. By this test it is possible to detect 1 part of copper in 2,500,000 parts of water.

Concerning the treatment of the small lake at City Park, this was done for experimental purposes in order to determine the effect of copper sulphate upon water which was very badly affected by the presence of algæ, the surface of the water being covered for the most part with a green scum and a disagreeable fresh corn odor was quite annoying. It was thought if the copper would eliminate the algæ from this water, that it certainly could be used with good prospects of success in freeing the company's reservoirs from the unpleasant effects of algæ, should occasion require, and this proved to be necessary within two months thereafter.

Very truly yours, Geo. T. Prince,
Denver, Nov. 13. Chief Engineer.

[The enclosures mentioned are two tables, which it seems hardly necessary to reproduce in view of the summary of the tests at Marston Lake, given in the letter, and the following notes concerning the experiments at the City Park lake. Before treatment there was a green scum over the greater portion of the whole lake and B. coli was present. The bacterial count was 6,200 per c. c. Twelve hours after treatment the bacterial count was 5,900, but the sample was taken so late at night that it was not possible to determine the appearance of the surface. One day after treatment a thick scum covered an arm of the pond and there was a blue-green scum around the edges on the shore; the bacterial count was 135,000. Two days after treatment the water was quite turbid and the surface scum was scattered all through the lake; the bacterial count was 130,000. Three days after treatment, the lake had cleared up some and the surface scum was practically all gone. Four days after treatment, there was no surface scum left and the water was much clearer; the bacterial count was 82,000.]

Engineering Careers in Foreign Countries.

From the article entitled "Should an Engineer Begin His Career in a Foreign Country," appearing in The Engineering Record for Aug. 12, 1905, it may appear to some of your readers that the author has taken a too narrow view of the question. We need not seriously consider the college graduate who has fanciful dreams of the riches of South American countries; nor one who expects to go to a foreign country in the capacity of an engineer, to soon become the owner of a large coffee, cane or rubber plantation or a mine owner; nor the man of insufficient foresight who, failing to know the conditions of the country, does not examine fairly all the phases of the venture. But the young man just out of college, financially straitened, if you wish, may have such reasonable foreight as any engineer should have, so that, on looking into the conditions of an offered foreign field, he may see good reason to pursue the profession abroad for a time, both for his profit and the advantage of a wide outlook.

Possibly the young man goes to foreign countries more often for railroad work than for any other branch of engineering. He may leave his home "the hero of the hour;" I am sure there is no harm in that. He may have no bitterness on leaving, for he is one of a large or small party. He expects to return at the end of a year or so, and knows right well that were he to work only a few hundred miles from his home he would return home no sooner. "The sea voyage out is delightful" if he can enjoy his dinner; but more, it is a valuable education to the average young man. Arriving at his destination, provided the "foreign country" is in the tropics, he finds the climate a little warm, but no more so than he would have found on a bright sunny day over gravel ballast in his own country.

It is seldom we find "an engineer beginning his career" placed at once in charge of work. It is especially true in railroad work that he must first serve at the instrument. If our young engineer is on a preliminary or location survey or on construction, he is first given a transit or level, which is as much as he would have had in the States. The work is carried on by his party of Americans by American methods. Where will he be able to see greater difficulties overcome, to give him the desired experience necessary for a higher position, than in South America? Plains for plains, mountains for mountains, can the States offer him more?

As for the climate, we have considered that he looked well to that before he left home. Under the very equator in Ecuador in the mountains and down the slopes to an altitude of 2,500 ft., he will find throughout the year the same temperatures that pertain to the mountains in the States during the summer months. His exposures to the tropical rains will not hurt him nearly as much as the exposure in the winters in the northern States.

As for his associates, they will, if anything, be better than they would be on a similar survey in the States. They will be the men of his own party. Instead of running into town for a "blow out" about once in so often, as is often the case in the States, the same man in the foreign country would not care for the native town and would stay in camp and save his money.

After a year or year and a half in the foreign country, let this young man return home and take stock of himself on the way, as did the engineer of the article. He will find about as follows: His college debt is paid or he has a small sum laid by for the idle day, or, it may be, having gone to the west coast of South America from New York, he returns by way of San Francisco and across the States, spending part of his money, as the author might say, "cowboy fashion," but, as he returns, on behalf of his education becoming better acquainted with his own country and seeing many engineering feats the very seeing of which may be of exceeding value to him at some later day. He has not lost his friends, for he has kept up a good correspondence with those worth having.

He is a broader, more self-reliant man for his experience among a strange people. His interest in the world-life has been increased. His morals have not depreciated more than they would have in the States, for he has been with the same class of men he would have found on a similar survey at home. He has served a year of his apprenticeship as instrument man under the most favorable circumstances. The wandering spirit, prevailing more or less in every young engineer, has been given a trial. He has learned the value of his home, and become better aware of the loss of his family, which item counts not a little in the success of many men.

If we are allowed to consider the first years of an engineer's life, years of experience in the elementary phases of his profession, the writer would draw the conclusion that for the man and the work here considered, the first year or so spent in a foreign land would give better results for the ultimate end than if spent in his own country.

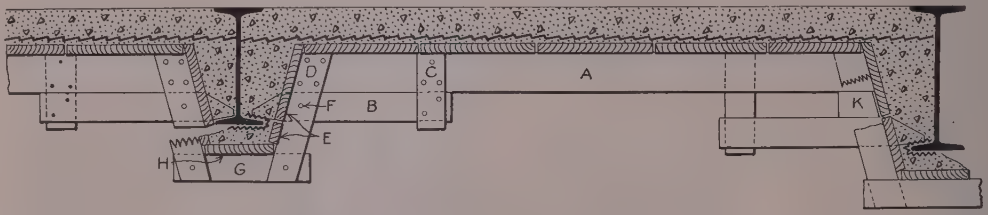
Ambato, Ecuador. Reader.

Wood Forms for Concrete Floors.

Sir: The writer has used and found very satisfactory the method of constructing forms for reinforced concrete floors on steel beams shown in the accompanying illustration. He has found it more economical both in the use of lumber and labor than other methods in general use, and submits it for publication with the hope that others may profit by it, or be persuaded to describe in the pages of this journal better methods which they have used.

The forms consist essentially of the pieces, *A* (2x4-in. for spans of not more than 6 ft.) and the 2x3-in. triggers *B* which rest on the lower flanges of the beams and thus support the forms. The trigger is secured at one end to the piece *A* by a 1x3-in. cleat *C* and at the other end by 1x3-in. cleats *D*, on either side of *A*, which serve, also, as supports for the batter boards, *E*. The sixpenny nail *F* is but partly driven, and it is to be drawn before removing the forms.

When soffits of the beams are not fireproofed, the cleats *D* extend to the bottom of the trigger *B;* but, otherwise, one cleat extends lower to secure the cross strip *G*. To remove the forms, draw the partly driven nail *F;* knock off the strip *C*, or loosen it enough to draw the nails in *B;* pull the triggers on one beam and the forms will drop. If the soffit board *H* is used it is necessary first to remove the strip *G*.



Method of Supporting Forms for Concrete Floors.

For larger beams use spacing blocks *K*, placed as shown. For smaller beams omit the trigger *B* and extend *A* to rest on the flange of the beam. *A* must then be cut, preferably near the beam to remove the forms.

The forms as described above have been used in the construction of two floors in the U. S. Post Office and Court House building now being erected in Huntington, W. Va., removed and placed in another story ready for the concrete.

W. A. Etherton.

Huntington, Nov. 13. Constructing Engineer.

Breakage in Sewer Pipe.

Sir: I am just in receipt of a communication from the president of a large sewer pipe company, a criticism of my paper on "Breakage in Sewer Pipe," read before the Sanitary Section of the Boston Society of Civil Engineers, a résumé of which he read in the Record, which I think of sufficient interest to ask you to publish in order that we may have all points of view upon the subject. The president of the sewer pipe company writes:

"So much 24, 27, 30, 33 and 36-in. sewer pipe has been put in various parts of the country the past six or seven years, that it seems preposterous for anyone to say that a pipe cannot be laid without concrete with safety. I do not wish to go into detail in reference to this matter, as I do not think it is of moment enough to do so. Your stand, however, is entirely in the wrong, in my opinion, and the best proof of this is the fact I have stated above.

"The only trouble with pipe in the ditch is the manner in which it is laid, and as some people embed sewer pipe it would almost break iron pipe if put in the same place. When you think of the thousands of miles of sewer pipe, 24 in. and larger sizes, which are to-day doing the work in this country, east, west, north and south, without the slightest particle of trouble," (the writer does not state how many of these sewers have been carefully examined for breaks or been crawled through to discover actual breakage, although we know that most all large sewers throughout the country laid through wet ground, are leaking more or less badly) "any other stand on this question is simply preposterous.

"The practical use of sewer pipe has been so well established in every section of the world that one man's opinion cannot materially affect its use. I have changed my mind, however, about single strength pipe in deep cuts, and believe it should be double strength."

Or, in other words, because everybody uses it it must be all right!

In my judgment no material can take the place of vitrified tile pipe for sewer work within certain limits. A determination of these limits and a restriction of its use within these proved limits cannot but benefit and not hurt the sewer pipe industry. One manufacturer told me that he loses money on all the large sizes of pipe, but that he must keep them because his competitors do so.

Yours respectfully,

Alexander Potter.

New York, Nov. 16.

The Responsibility of a Contractor for injuries to workmen on scaffolds was recently stated at length in a decision of the U. S. Circuit Court for the Southern District of New York in Hutton v. Holbrook, Cabot & Daly Contracting Co. The syllabus of the decision in 139 Fed. Rep. 734, reads as follows: "The provisions of the New York labor law relating to scaffolding, which prohibit an employer from furnishing to workmen engaged in the erection of a building or structure any scaffolding, ladder or other mechanical structure which is unsafe, unsuitable, or improper, impose an imperative obligation on an employer, when it is his duty to furnish a scaffold, to furnish a safe one, without exception on account of the carelessness of his servants; but they do not mean that his obligation shall be imperative, when he has furnished a safe one to his workmen, to see that they use proper care in moving it and in re-erecting it from time to time as the nature of their work requires, nor that when he has furnished proper materials for a safe scaffold to workmen, who, in the usual course of their employment, are to build it, he shall be liable to them in the event that, by their neglect or misconduct in its erection, it proves unsafe, and an injury results. In such case the general rule as to the negligence of fellow servants applies.

CURRENT NEWS SUPPLEMENT

NOVEMBER 25, 1905.

DIRECTORY OF NATIONAL TECHNICAL AND TRADE SOCIETIES.

American Society of Civil Engineers. Secretary, meeting, Dec. 6; paper on New Graving Dock, at Nagaski, Japan.

American Society of Mechanical Engineers. Secretary, F. R. Hutton, 12 West 31st St., New York.

American Institute of Electrical Engineers. Secretary, Ralph W. Pope, 95 Liberty St., New York Next meeting, Dec. 15, 44 West 27th St., New York.

National Fire Protection Association. Secretary, W. H. Merrill, Jr., Chicago.

American Institute of Mining Engineers. Secretary, R. W. Raymond, 99 John St., New York.

American Institute of Architects. Secretary, Glenn Brown, Washington, D. C.

Association of Engineering Societies. Secretary, Frederick Brooks, 31 Milk Street, Boston, Mass.

American Society of Heating and Ventilating Engineers. Secretary, W. M. Mackay, 235 Water St., New York.

Canadian Society of Civil Engineers. Secretary, Clement H. McLeod, 877 Dorchester St., Montreal.

American Public Health Association. Secretary, Dr. C. O. Probst, Columbus, O.

Society for the Promotion of Engineering Education. Secretary, Prof. M. S. Ketchum, University of Colorado, Boulder, Colo.

American Society for Testing Materials. Secretary. Prof. Edgar Marburg, University of Pennsylvania, Philadelphia, Pa.

American Society of Municipal Improvements. Secretary, George W. Tillson, Room 12, Municipal Building, Brooklyn, N. Y.

Association of Railway Superintendents of Bridges and Buildings. Secretary, S. F. Paterson, Concord, N. H.

American Railway Engineering and Maintenance of Way Association. Secretary, L. C. Fritch, 1562 Monadnock Block, Chicago.

American Water-Works Association. Secretary, J. M. Diven, Charleston, S. C.

American Foundrymen's Association. Secretary, Richard Moldenke, P. O. Box 432, New York.

Engine Builders' Association of the United States. Secretary, J. L. Lyle, 39 Cortlandt St., New York.

American Public Works Association. Secretary, W. H. Flint, Chattanooga.

Association of American Portland Cement Manufacturers.. President, J. B. Lober, 1232 Land Title Building, Philadelphia.

American Society of Refrigerating Engineers. Sec-Annual meeting, Dec. 4-5; 12 West 31st St., New York.

National Association of Manufacturers of Sand-Lime Products. Secretary, H. A, Duerr, Wilmington, Del. Next meeting, Dec. 5-7, Detroit.

National Association of Cement Users. President, Richard L. Humphrey, Harrison Building, Philadelphia, Pa.

AIR POWER IN THE UNION PACIFIC SHOPS AT OMAHA.

Compressed air has become as essential in railway shop work as steam for power, or electricity for lighting. Hardly a process of locomotive or car building and repairing is not aided by some form of air tool. The air compressor, as the source of power for these pneumatic tools, assumes an important place in the shop equipment. In the shops of the Union Pacific Ry., at Omaha, air power has been carried to a degree of application probably surpassed in no other shop of the country, and the extent of its use has made necessary an air compressor installation ranking among the largest for this purpose.

The buildings comprising the various departments of these shops are compactly grouped beside the yards. The power house is at the south of the main group and was one of the shop buildings under the scheme in effect before the late improvements and rearrangement. This fact accounts for some features of power house arrangement which differ from usual practise where the building is designed to suit the work. A longitudinal firewall separates engine and boiler rooms. The boiler equipment was selected to meet the conditions of very limited space. For this reason it is made up of six marine sheel boilers, with internal fire-boxes. These units are rated at 250 h.p. each, giving a total capacity to the plant of 1,500 h.p. Hand firing is employed, the coal being dumped on the fire floor from cars on the side-track paralleling the power house. The steam pressure carried is 150 lb.

The main steam header for the power plant is in the boiler room, in the rear of the boilers. It is sub-divided and protected by valves according to the best practise. All engine room exhausts unite below the floor in a header leading to the exhaust head above the roof. From the steam header, steam pipes to all engine-room units pass through the fire-wall and lead to the cylinder through wide-sweep bends. Separators are on each steam pipe just within the engine room, and all steam piping is protected by insulating covers.

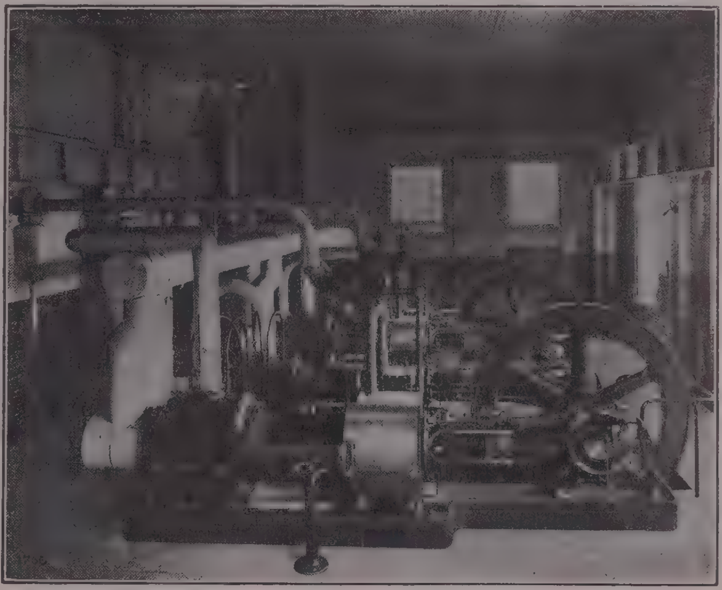
The engine room contains two air compressors built by the Ingersoll-Sergeant Drill Co., New York. They are of duplex pattern, with cross-compound steam and air cylinders. The type is designated by the makers as Class GC. The steam cylinders are sheathed and insulated and equipped with Meyer balanced adjustable cut-off valves. A reheating steam receiver between the high and low pressure cylinders draws live steam from a by-pass inside the throttle. The standard Sergeant "air ball" governor regulates speed and pressure by throttling the steam supply. A by-pass pipe taken from the steam pipe inside the governor leads to the low-pressure steam chest. It has a pressure reducing valve which ordinarily is closed, but when the governor throttles the steam supply and the pressure on the high pressure cylinder reaches a certain minimum, this valve opens, admitting live steam directly to the low-pressure cylinder through the by-pass pipe, thus equalizing the work in the two steam cylinders.

The high and low pressure air cylinders are water-jacketed on heads and barrels. Both cylinders are fitted with the Sergeant piston inlet valve. The discharge valves are of the vertical direct-lift pattern, readily accsssible. A somewhat novel style of air intake is used. The inlet tubes of the low-pressure cylinders are surrounder by a sheet iron case, leading to a vertical riser of sheet steel pipe which connects with a main intake header carried to an opening outside the engine room. Traps in the intake casing give easy access to the piston tube and stuffing box. The intercooler of each unit is of the vertical receiver type, with tinned brass tubes for the cooling water and an ample air storage capacity. Proper provision is made for withdrawing condensed moisture and the entire intercooler and connecting air pipes are covered with insulating material.

Each compressor has a free air capacity of 2,216 cu. ft. per minute, when running at 120 r.p.m. The air pressure is maintained at about 110 lb. on the receiver, giving an average working pressure of 100 lb. throughout the shops. The air cylinders are 16¼ and 24¼ in. in diameter; the steam cylinders are 16 and 24 in. and the stroke is 18 in.

The main air pipe passes underground to the shop buildings and radiates to the several departments. All piping in the buildings, air, water and gas, is carried in shallow conduits in the floor with removable covers. Branches with valves rise at each post for connection with shop appliances.

The applications of air in the shops are those common to railway repair work. In the locomotive shop, air drills in various sizes are used for drilling, reaming and tapping; chipping and riveting hammers have their usual place; pneumatic stay bolt cutters assist in dismantling fire boxes. A small rotary air motor drives gearing for turning locomotive drivers in setting valves. Another operates a cylinder boring machine. Air hoists and air jacks assist in the handling of heavy parts. Pneumatic presses find a ready place in certain classes of work. In the air brake testing department, air pressure is drawn from the main plant. An interesting device here is a pneumatic pressure coupling which holds the valves under test against the supply pipe, saving the time and trouble of screwing them in place. In the yards, warehouse and foundry, air hoists appear on every hand. In the car shops pneumatic drills find manifold uses, and air jacks assist in many operations. Cars are sandpapered and paint is removed and applied by air appliances. Practically all cleaning is done by the air blast.



AIR COMPRESSORS AT THE UNION PACIFIC SHOPS, OMAHA.

THE SYSTEM OF THE HUDSON COMPANIES.

In the Oct. 7 issue of The Engineer Record, an account was given of the opening on Sept. 29 of one of the tunnels between Hoboken and Morton St., New York, of the Hudson Companies. Since that event the plans of the company for an extensive surface railway system in Jersey City and the equipment of a high-speed electric line between the present Pennsylvania Railroad terminal in Jersey City and Newark have been made public.

The system of tunnels forms a sort of belt line from Thirty-third St., Manhattan, down Sixth Ave., across the Hudson River to Hoboken, then back from Jersey City to the corner of Cortlandt and Church Sts., with spurs on Ninth St., Manhattan, and to the Lackawanna and Jersey Central stations on the New Jersey shore. At the Cortlandt St. station the company has secured two blocks on the west side of Church St. between Cortlandt and Fulton Sts., where two huge terminal office buildings will be erected. Contracts have already been let for this work, and all tenants have been notified that they must vacate before Dec. 1, when the work of demolition will begin. Between this terminal and Broadway, an underground passage will be built in Dey St. so that passengers from New Jersey can walk underground to the Fulton St. station of the Interborough Rapid Transit Company. The stations for the subway in New York on Sixth Ave. will all be located underneath the stations of the elevated railway.

In addition to the surface system in Hudson County, which comprises 52 miles of track, the company will equip a high-speed line between Jersey City and Newark. For this purpose two of the existing tracks of the Pennsylvania Railroad between these cities have been secured. Under the new plans of the Pennsylvania Railroad, all its through trains will run from Newark north until the terminal of the present Thirty-fourth St. tunnel on the Jersey side is reached, and these trains will all enter the new Pennsylvania station at Thirty-fourth St. and Seventh Ave. This will leave the line between Newark and Jersey City free for the operation of electric tunnel cars of the Hudson Companies. It is proposed to run through trains by this route from Newark to Church St., New York, in 20 minutes. As the line approaches Newark, the tracks diverge from the Pennsylvania tracks and will be depressed so as to pass under the Passaic River by tunnel. A subway is then to be constructed up Market St. to High St. and around the Court House in Newark.

In addition to the railway plan already described, the same interests have purchased the property of the Hackensack Meadows Company, and have organized the New Jersey Terminal Dock & Improvement Company, which will develop the now largely useless tract of the meadows between Jersey City and Newark. Here the company is planning to build a large power station to supply current to all of its railway system.

The company which is building the four tunnels is the Hudson Companies, a New York corporation with a capital of $16,000,000 preferred and $5,000,000 common. After the tunnels are completed they will be operated by the following companies:

The Hudson & Manhattan Railroad Company will operate the tunnels in New York State between the center of the river and Church St. The Hudson & Manhattan Railway Company will operate the tunnels from the center of the river in New Jersey to the Erie Railroad station. The Hoboken & Manhattan Railway Company will operate the tunnels from the Erie station to the Delaware, Lackawanna & Western station and to the center of the river at the foot of Fifteenth St., Jersey City. The New York & Jersey Railroad Company will operate the tunnels from the center of the river up to Thirty-third St., New York and Astor Pl., New York. The Hudson Street Railroad Company is the company which will build and operate the street railway system in Hudson County.

As already announced, the consulting engineer in charge of this work is L. B. Stillwell, who is being assisted by Hugh Hazleton.

INSPECTION OF PUBLIC WATER SUPPLIES IN NEW JERSEY.

With the enactment in 1899 of the law to prevent the pollution of streams the first systematic inspection of the sources of public water supplies in New Jersey was undertaken. The State Board of Health was entrusted with the work and the annual reports of that board show the results which have been accomplished. The records show that the watershed of the Hackensack River, the water of which is distributed to more than thirty towns, has been almost entirely freed from direct sources of pollution, 254 sources of contamination having been removed, leaving only three known points of pollution, and these cases are at present receiving the attention of the Chancellor. The Pequannock watershed, which supplies the city of Newark, has been found to be remarkably free from sources of pollution, and those which are at present existing, three in number, are now under consideration by the court. The Rahway River has been condemned by the State Board of Health as a source of water supply, and the authorities of the city of Rahway have been advised to secure a new supply. The Maurice River is being polluted by the sewage from the borough of Vineland, and a suit in chancery has been instituted to prevent the further contamination of the waters of this stream. Regular periodical examinations of the public water supplies of a few of the larger towns of the State have been conducted in the State laboratory of hygiene for several years, and recently this service has been extended to include the following localities: Hoboken, Jersey City, New Brunswick, Princeton, Rahway, Lakewood, Bridgeton, Boonton, Bordentown, Millville, Morristown, Elizabeth, Camden, Atlantic City, Asbury Park, Long Branch, Trenton, Perth Amboy, Plainfield, Passaic, Orange and Newark.

The purpose ot these laboratory examinations of the water is to supplement the inspection of the streams, and to furnish information which will indicate any changes which may occur in the quality of the water, and in this manner assist in detecting new or undiscovered contaminations.

A NEW FAN FOR INDUCED DRAFT.

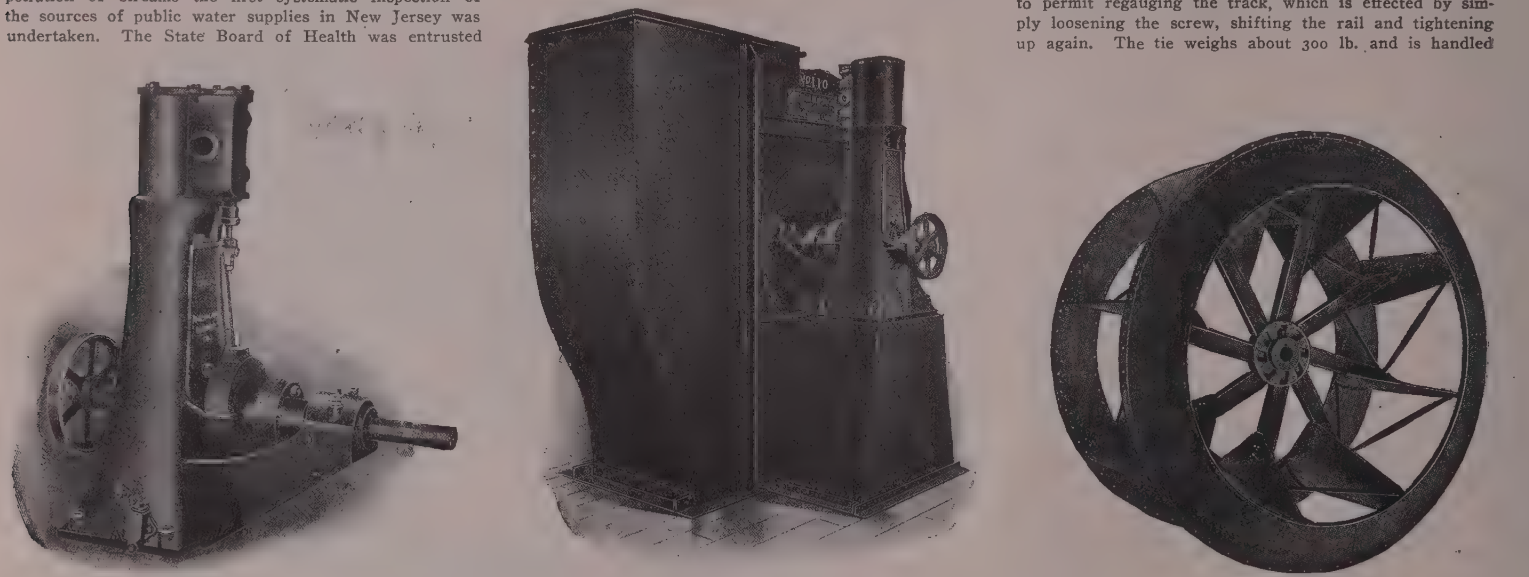
Experience has shown that in handling hot gases with a fan, as in a plant producing induced draft for boilers, it is difficult to give the fan shaft a suitable bearing at the inlet side. A bearing here would necessarily be situated in the inlet area and would be constantly surrounded by hot flue gases. A substitute for this system can be obtained by the use of an over-hung wheel, having, in addition to the two engine bearings, a bearing on the engine side of the fan, but none on the inet side. The provision for a third bearing separate from the engine, has, however, given trouble from the fact that this bearing cannot readily be lined up with the two engine bearings.

The accompanying illustrations show a new method of construction to overcome this trouble. All three journal boxes are cast in the engine frame and can all be bored with the same boring bar, which makes it impossible for them to be out of line. The fan-bearing is water-cooled and ring oiled. From the fact that all bearings are bored at once, a self-aligning bearing such as would otherwise be necessary is not required here, still further simplifying the arrangement. In addition to these points, it will be noticed that the bearing is supported by the engine bed and not by the housing of the fan as would otherwise be the case, which simplifies the construction by doing away with the additional bracing usually found on fan housings.

The wheel is varied somewhat from the ordinary construction. In place of the usual three spiders is substituted one heavier one, built of I-beams cast into the hub. The blades are braced upon each other as shown in cut. The wheel constructed in this manner has been shown, the makers state, to be fully as strong and rigid as the ordinary three-spider form.

By the use of a single spider the necessity for more than one hub on the shaft is obviated, and the load of the wheel is concentrated upon a comparatively short length of shaft. Moreover, with the deep cone in the casing and the fan bearing sitting far in, the load of the fan is placed very near to the fan bearing; in fact, the bearing is included within the width of the fan blades. This point is considered of great importance by the makers, since were the fan of the ordinary three-spindle design, the center of gravity would be some distance out from the bearing and there would be the tendency of the shaft to move on the fan bearing as a fulcrum and cause an upward thrust in the engine and on the engine journal caps. With the single spider, this trouble is not encountered.

The engine is of the enclosed type, oiled by a recently devised pump which distributes streams of oil over all of the reciprocating and revolving parts, even lubricating the eccentric outside of the frame. Tests in actual practice have proved that it will run several months without oiling or adjustment. This outfit is manufactured by the American Blower Co., Detroit, Mich.



A NEW FAN FOR INDUCED DRAFT AND OTHER PLANTS WHERE HOT GASES ARE HANDLED.

The new publications of the Allis-Chalmers Co., Milwaukee, include one on forged steel balls for tube mills, one on portable rock crushing plants for railway and general contracting work, one on the Bennetts pouring spoon for use in converting stands of copper plants, and an elaborate catalogue of sampling mills, ore breakers, crushing rolls, sample grinders, automatic samplers, elevators, conveyors, bin gates, grizzlies, ore barrows, scales, engines, electric equipment and accessory apparatus.

THE CHENOWETH REINFORCED CONCRETE TIE.

A section of track, 112 ft. long, on the Rapid Transit R. R. in New York, near the Dyckman St. station, has been laid with 5x7-in. reinforced concrete ties 8 ft. long. These carry the 100-lb. running rails, and the third rail is supported by every third tie, which is made longer than the others. The tie has a reinforcement of No. 16 steel wire netting 3 ft. wide, 8 ft. long and 1½-in. mesh, stiffened by a ⅝-in. square winding rod and four 5/16-in. longitudinal reinforcement rods. The concrete, made 1:2:3, with Atlas Portland cement and ¾-in. paving gravel is spread in a uniform layer over the wire netting and the latter is rolled up around the longitudinal winding rod as an axis by a special machine so as to form an approximately cylindrical mass of concrete. This is placed while still wet in a rectangular mould, the exact size of the tie, concrete is filled in the corners and the whole is subjected to heavy pressure, which makes the concrete homogenous and causes it to fill the rectangular mould and have a very smooth surface. Steel pins are then driven through the mould to make holes for the rail-fastening bolts. The tie may be removed and set in the track when one day old, although it is usually allowed longer to harden.

The rail is seated on oak cushions and is secured by cast-iron bevelled clips held down by lag screws which engage spiral vertical steel springs in the lower part of the tie, acting like expansion bolts. Before the screw is put in place it is dipped in tar and a rubber washer and short section of rubber tube are used to insulate it. After the fastening is completed the top of the clip and tie are asphalted to protect them from metallic dust. The clip has an oval bolt hole which allows ¼-in. movement, to permit regauging the track, which is effected by simply loosening the screw, shifting the rail and tightening up again. The tie weighs about 300 lb. and is handled by four men with wooden cant hooks and with pairs of tongs, similar to ice tongs, with rings in the tops of the handles through which carrying bars are placed. A section of trial track 1,000 ft. long has, it is stated, been ordered for the Pennsylvania Lines west of Pittsburg. The system has been devised by Mr. A. C. Chenoweth, 16 Court St., Brooklyn, N. Y.

PROGRESS ON THE BLACKWELL'S ISLAND BRIDGE.

The steelwork on the Blackwell's Island bridge across the East River at New York is now well under way, and is going ahead rapidly. Over fifteen hundred tons of steel are already in position on the west pier on the island. The huge red members loom up above the penitentiary buildings on the island, and are plainly visible from all parts of Long Island City. The first two pieces that were erected after the traveler was rigged were the lower halves of the main diagonals, which are 105 ft. long and weigh 80 tons. At the rate at which the builders are proceeding now, the steel will be placed in position, averaging 2,000 tons per month, and by December 6, it is expected that at least 4,500 tons of permanent work will be in position. There is now about nine thousand tons of steel for the span on the ground, and an additional two thousand tons are awaiting removal from Jersey City. The total amount of steel to be used in the permanent span between the two Blackwell's Island piers and the two cantilever arms, which will extend half way over each of the East River channels on both sides of the island is 25,500 tons. The entire work, it is expected, will be completed in October, 1906.

THE CONDITION OF THE ELECTRICAL INDUSTRY.

The annual convention of the district managers of the Westinghouse Electric & Mfg. Co. was held Nov. 13-16, at the general offices of the company at East Pittsburg. Mr. R. L. Warner, New England manager of the company, acted as chairman of the meetings, which were attended by the following representatives: C. S. Powell, general agent, New York; W. F. Zimmerman, representative, New York; Maurice Coster, manager export department, New York; W. C. Webster, assistant to second vice-president, New York; F. H. Shepard, New York; G. Pantaleoni, general southwestern manager, St. Louis; J. R. Gordon, Atlanta; H. H. Seabrook, Baltimore; D. E. Manson, Boston; C. W. Underwod, Buffalo; T. P. Gaylord, Chicago; C. W. Regester, Cincinnati; G. B. Dusinberre, Cleveland; J. E. Johnson, Dallas; L. M. Cargo, Denver; C. F. Medbury, Detroit; T. J. McGill, Minneapolis; C. A. Bragg, Philadelphia; W. F. Fowler, Pittsburg; D. E. Webster, St. Louis; W. W. Briggs, San Francisco; M. P. Randolph, Seattle; Paul T. Brady, Syracuse.

At the opening session addresses were delivered by Mr. E. M. Herr, first vice-president of the company; by Mr. Frank H. Taylor, second vice-president, and by other officials. During the four days of the convention papers on topics of general interest were read by many of the officials and managers and by representatives of allied companies. On Wednesday evening the delegates and representatives of the local Westinghouse Companies were entertained at the Hotel Schenley by Mr. E. M. Herr.

PHOTOGRAPH TAKEN DURING THE CONVENTION OF THE DISTRICT MANAGERS OF THE WESTINGHOUSE ELECTRIC & MFG. CO.

At no time in the history of the company have the managers spoken with more enthusiasm of the business conditions in their respective territories. Among these opinions expressed were the following: "I have it from the lips of a representative of one of the largest commercial interests in South America that the people in those countries would rather buy American machinery than buy European goods." This statement was made by the manager of the export department. Speaking further on the prospects for export business, Mr. Coster said: "The outlook for foreign trade has never been brighter than at present. The superiority of American machinery as compared with European manufacture is being demonstrated every day, and in these markets where the Germans and English have heretofore enjoyed a monopoly, America is now gradually obtaining the lion's share of the business. As far as the Westinghouse Companies are concerned, we are enjoying the particular advantage that the name of Westinghouse is well known the world over, that our goods are used in every country on the globe, and hence we have no difficulty to obtain business for our companies."

Among the other attendants at the managers' meeting, R. L. Warner, the New England agent, stated: "The business outlook in New England was never brighter than at the present time, and especially does this refer to the Westinghouse Electric & Mfg. Co. Our product is constantly growing in favor, and I also believe that the fact of the New York, New Haven & Hartford R. R. Co. being about to operate its trains by the single-phase locomotive, will be a great factor upon the electric railway business of the Westinghouse Companies."

Mr. F. H. Taylor, second vice-president, said: "I feel that this is a subject of congratulation, not only to ourselves, but also to the entire business interests of Pittsburg. That the prospects for prosperity in our works never will be brighter than at present. While we are already in possession of the facts which prove that the year of 1905 has been the banner business year in the history of the factory, we have every reason to believe from the assurances given us by our district managers from all over the country, who have now been in session here, that the industrial advancement throughout this country promises an unprecedented activity, and that our company will reap the benefit of this activity in a measure perfectly satisfactory to the company. I look for the business of 1906 to be materially larger than that of 1905."

Mr. C. S. Powell, general agent, New York City, said: "The adoption of electricity by the Pennsylvania Railroad on its lines, Eastern Division; by the New York Central on part of its lines, and the decision of the New York, New Haven & Hartford R. R. Co. to operate trains with the single-phase locomotive will prove a great impetus toward increasing the future business in the electrification of railroad lines throughout the country. As the progress and development of this matter began in the East, so I foresee the advancement of electric railroading in the fact that these Eastern railroads have set the ball rolling in that direction."

Mr. T. J. McGill, the Northwestern agent, located at Minneapolis, in speaking of the business outlook in that part of the country, said: "Every indication at present in the Northwest leads me to believe that 1906 is going to be the greatest year in history. The record-breaking crops of 1905, at high market values, have greatly increased our local wealth and have attracted a large volume of outside money for investments. The railroad traffic, all building operations and bank clearances have had a marvelous increase and a healthy one. Further, the beneficial results are pre-eminent. At one time the Northwest was only known as a sparsely inhabited section, but we must now agree with Mr. J. J. Hill, who says that it ranks as an empire."

Mr. J. R. Gordon, the representative of the South, with headquarters at Atlanta, stated: "The development of the South within the last five years has been truly phenomenal. Business, commercial and manufacturing enterprises are daily increasing. Electricity has had as much to do with this development as any other factor, on account of the fact that it has made possible utilization of the many waterfalls which are located in that section of the country. These waterfalls are now being rapidly developed and the power is used for driving the machinery in the old manufacturing plants and gives a new impetus to the establishment of others."

Mr. L. M. Cargo, representative for the district comprising Colorado, New Mexico, Wyoming, Utah and Idaho, stated: "The new discoveries of valuable minerals are made in our district almost every hour, and the wealth of gold, silver and copper, especially the latter, is inestimable. This means a greater development of the mining industry of that country than has yet been dreamed of, and, inasmuch as the application of electricity makes the operation of mines an easy task, we are looking for a great business in that branch of the industry."

Mr. W. W. Briggs, of San Francisco, said: "The people on the Pacific slope are looking forward to a period of uninterrupted prosperity. I believe that the development of interurban railway business has only just commenced and with the perfection of the single-phase locomotive and the steam turbine this particular branch of the business will be very much greater than it has been heretofore."

Mr. C. A. Bragg, district manager of Philadelphia, reported: "In regard to the prospects for business in the coming year, they appear to me most flattering. If we have had successes in the past and banner years, I think the coming one will make them look insignificant as regards the amount of profitable business there is ahead of us. There is nothing in the horizon, that I can see, which will interfere with, not only our own business, but the general prosperity of the country. The indications are so strong that I cannot see how they can in any manner be harmed."

In 1878 Walter H. Geissinger began practice as a mill architect in Philadelphia, and a little later took Edward M. Hales into partnership. From this beginning has developed the large practice now conducted by Messrs. Ballinger & Perrot, at 12th and Chestnut Sts., in that city. Some of their most important structures have been described in this journal. A large album has recently been issued by the firm illustrating many of their largest pieces of work in late years, which are particularly interesting because of the extensive use of reinforced concrete as well as standard mill construction. One large building, an 8-story and basement, 80x140-ft. printing shop, was built at two periods. The first portion, with steel frames, vibrated considerably when the presses were running, but after the second portion, constructed of reinforced concrete, had been erected. the vibrations were materially reduced.

THE IRON AND STEEL INDUSTRY.

The extraordinary conditions ruling in the iron and steel industry are referred to as follows in "The Iron Age" of this week:

"The bookings of finished iron and steel continue exceedingly heavy in all lines, and thus far this month are nearly up to the rate of October. That month was a surprise after the extraordinary record of September, which was not far from double the actual capacity of the mills. It is quite unprecedented that there should be such a volume of buying at this season of the year, when usually the works are eager for winter work. The strain in all directions is tremendous, and prices are kept down only by main force. In the week the leading interest advanced tin plate 10 cents a box, and the sheetmakers put up prices on sheets $2 a ton for black and galvanized. It is understood that the American Sheet & Tin Plate Co. has now 92 per cent. of its capacity in operation. Conferences among the wire manufacturers have resulted in a retention of current values, and in the plate trade an interchange of opinion has led to the continuance of the policy of holding prices uniform. Premiums, however, are paid with increasing frequency.

"In the structural trade the inability to make deliveries is still the conspicuous feature. The new mill at Chicago is running, but only on a single turn. A feature of the markets recently has been the demand for structural material and for plates from Canada, and quite a good business has been done in that direction. There is increasing evidence of a shortage of pig iron for steelmaking purposes. The Steel Corporation has purchased only a moderate quantity, since the sellers are holding their metal at an advance. Other interests, however, have taken round lots in the Pittsburg district, among them being a plant in the Philadelphia district, which has bought from six thousand to eight thousand tons at $17 at Valley furnace. In the East a demand for a considerable quantity of basic pig has made its appearance, due to the retention of metal in the Pittsburg district which thus far has been delivered to the East. It is hoped that some accumulation toward the end of the year, when the steel works naturally slacken their output while the blast furnaces continue in operation, may lead to a much desired accumulation of pig metal.

ELECTRIC CABLEWAYS FOR SHIPBUILDING.

An overhead electric-driven cableway system has been erected by the John A. Roebling's Sons Co. at the Eastern Shipbuilding Company's works, New London, Conn., for the purpose of handling all the material required for shipbuilding. The plant erected fills all the functions of a traveling crane. The cableways were first used in the building of the two large steamships, "Minnesota" and "Dakota," for the Great Northern Steamship Company. These two ships were built side by side and the cableways handled the material for building both ships.

The plant consists of three steel spars, each 120 ft. high, 42 in. maximum diameter, 30 in. in diameter at base and 24 in. at the head. Each mast supports a steel cross-yard 174 ft. long, of rectangular cross section, strongly braced. The yards are suspended 84 ft. above the ground, and are amply stayed and guyed with steel wire rope, varying in size from 1⅜ to 2½-in. diameter, all intermediate sizes being used, ranging in strength from 75 up to 256 tons. The masts are set 300 ft. apart. Between the cross-yards is stretched a cast-steel wire rope, on which the carriage travels that lifts and conveys the load. The cables are arranged to travel from end to end of the cross-yards, 174 ft. on Z-bar tracks, attached to the top of the cross-yards.

The cables between the cross-yards make practically two cableways covering an area of 600x174 ft. and are operated by winding machinery placed in a house or operating room, built around the main mast just below the cross-yards—resembling somewhat the "fighting top" of a military mast. Each winding machine consists of a three-drum hoist, driven by a 35 h.-p. electric motor, revolving at a speed of 550 revolutions per minute, geared so as to give a speed of 68 revolutions per minute to the drums. One drum is employed to raise and lower the load, one to move the load along the cable, and the third to move the cable along the cross-yards.

The fall block can be lowered from the cable to the ground in 10 seconds—a load of 5,000 pounds hoisted to the cable in 30 seconds. The cable will travel from one end to the other of the cross-yards in 30 seconds, and during the same time, the carriage will travel from one end of the cable to the other.

The main cables on which the carriages travel are 2 in. in diameter. The hoisting and traction ropes are ⅜-in. diameter. The carriages used are regular patented self-oiling carriages. Each cable works independently of the other. One can convey the material to one ship, while the other is conveying the material for the other ship, or they can both handle material for different parts of one ship. As the plant is installed, two carriages are employed, but it is so constructed that four different carriages could be used at the same time, each handling a load of 5,000 pounds.

A NEW GASOLINE MOTOR CAR FOR RAILWAYS.

The circulation departments of several daily newspapers have lately been using gasoline motor cars running on the regular railway tracks, so that the delivery of papers is independent of train schedules. These cars are made by Fairbanks, Morse & Co., and are the result of several years of experience in the manufacture of gasoline cars for inspectors, section gangs and construction purposes. The company has lately built larger and more elaborate cars for high speeds and heavier loads, and in one of them Mr. George H. Webb, chief engineer of the Michigan Central R. R., made an inspection of that road during the last summer. Some of the results of the run are the following:

The total distance traveled by the car was 4,347 miles and the total amount of gasoline used was 231 gal., or an average of 19.7 miles per gallon of gasoline. The records show that on the run from Jackson to Allegan, a distance of 175 miles round trip, only 7½ gal. of gasoline were used, or 23.3 miles per gallon. The total cost per mile, including lubricating oil, battery cells and everything excepting wages of man in charge, was nine-tenths of a cent. Most any railroad man can figure out that this is quite a saving as compared with a steam locomotive pulling a private car.

This gasoline car has its advantages also because of its ability to attain a high rate of speed and maintain it on a long run. From Marshall to Allegan, 66.4 miles distance was made in one hour and forty minutes, or at the rate of 40 miles per hour, and the engine was never stopped once. The distance from Tekonsha to Harris, 29 miles, was made in 45 minutes, and the best run of the entire trip was made from South Haven to Kalamazoo, a distance of 39.6 miles, in 45 minutes, or the rate of 52.94 miles per hour.

The manufacturers report that there is a large demand for cars of this class now they have demonstrated that they are a complete success, and their factory with the present facilities is barely able to keep up with the orders.

A NEW DRY DOCK ON THE GREAT LAKES

Work on the new dry dock of the American Ship Building Co. at Lorain, Ohio, was commenced Oct. 1 last by the contractors, Messrs. Barnet & Record, of Minneapolis, Minn. The dredging of the slip is half completed and the pile driving of the protection has been commenced. The plans and specifications for the work were prepared by Messrs. Ritchie & Ruple, consulting engineers, Cleveland, Ohio, who are also superintending the construction. The dock will be the largest on the Great Lakes and among the largest in this country. The dimensions of the dock are as follows: Length on bottom from outer sill to head of dock, 732 ft.; length on top from outside of abutments to head of dock, 764 ft.; width of basin on bottom, 85 ft.; width of basin on top, 125 ft.; width of entrance on bottom, 75 ft.; width of entrance on top, 80 ft.; depth of water on inner sill, 15½ ft.

The gate will be of steel of the caisson type. The entrance abutments and aprons will be of Portland cement concrete, and will cover an area of 44 ft. by 173 ft. 8 in., extending from 4 ft. above the water to 32 ft. below it, and will be enclosed in a casing of 8x12-in. tongue-and-grooved sheet piling. The south abutment will be 32½ ft. by 44 ft. on top, and the north abutment 63 ft. 2 in. by 44 ft. In the latter abutment will be located the pump house 30 ft. by 26 ft., the floor of which will be 16 ft. below the top of the abutment. In this will be placed two 36-in. centrifugal pumps driven by electric motors placed on top.

The dock will be constructed on a pile foundation, and the basin will be of timber planked with 4-in. white oak. All the timbers except the plank will be of Oregon fir. The basin and abutments will be enclosed within a sheet piling protection, consisting of two lines of 8x12-in. tongued-and-grooved piling. The inner line of the protection will be 10 ft. from the coping of the basin, and the outer line will be 30 ft. from the inner. The two lines will be braced and tied by 12x12-in. timbers and 1¾-in. steel rods, and the slopes of the dock will be anchored to the inner line of the protection by 1¾-in. steel rods. About 400 ft. of the north side of the dock and the protection will be constructed in a slip now used for launching vessels, and will require extra heavy work for holding it when pumped out. The coffer dam will be of similar construction to the protection, only more strongly braced.

It is expected that the dock will be completed by the end of the year 1906.

Messrs. Ritchie & Ruple, the consulting engineers, also designed the first dry dock at Lorain in 1896. This was 500 ft. long and has been lengthened to 550 ft. As soon as the new dock is completed the old dock will be again lengthened. The same engineers also designed the dry dock of the Skinner Ship Building & Dry Dock Co., of Baltimore, Md., which is 600 ft. long, as well as several similar dry docks on the Great Lakes.

BUSINESS NOTES.

Orders for school heating and ventilating apparatus have been received lately by the B. F. Sturtevant Co., from Linden, Ind.; Salem, N. J.; Lowell, Mass.; Brooklyn, N. Y., and Oklahoma City. The company is now furnishing a complete system for a Buffalo public school.

Julian Scholl & Co., 126 Liberty St., New York, are issuing notices to contractors and cities desiring complete asphalt plants, calling attention to the importance of placing orders now if the equipment is desired for early delivery in the spring. The company is making a specialty of a plant having two portable sand dryers, a hot sand elevator and bin, three single melting furnaces, a double mixer, a cold sand elevator, a portable engine and a steel shed.

The Crocker-Wheeler Co., Ampere, N. J., has established an industrial engineering department in which is concentrated all its work in industrial engineering as applied to railway and machine shops and manufacturing establishments generally. Mr. J. K. Warner Davenport, formerly a consulting engineer making a specialty of industrial work, has become associated with the company in order that its increasing work along these lines may be handled as thoroughly and satisfactorily as heretofore. Mr. Davenport and his assistants are now giving their attention to several important propositions of this nature. Among those who have availed themselves in the past of the engineering services of the Crocker-Wheeler Co. may be mentioned the Lake Shore & Michigan Southern Ry., the John Simmons Co., the Bucyrus Co., the Ansonia Brass & Copper Co., the American Bridge Co., the Pittsburgh & Lake Erie R. R., the Joseph Dixon Crucible Co., and the Ingersoll-Sergeant Drill Co.

In order to care adequately for its continually increasing business, the American Blower Co., of Detroit, is erecting a three-story addition to its plant. This particular addition is rendered necessary by the growing popularity of the type A enclosed, vertical, self-oiling engine, which was placed upon the market a few years ago. The building will be of steel and brick construction. The first floor will be used for erecting and testing engines, a very complete new outfit being put in for the latter purpose. The power from engines under test will be absorbed by generators and air compressors. An electric crane will form part of the equipment in this department. The second floor will be used for storing engine parts and painting the completed engines, and the third floor will be utilized for storage purposes entirely.

The city of Alpena, Mich., which recently voted an issue of bonds to defray the cost of a municipal lighting plant, has contracted with Allis-Chalmers Co., of Milwaukee, for the complete electrical and power equipment. This consists of a 60-cycle Bullock alternating current generator, normal capacity 150 kw., direct connected to a Reynolds-Corliss cross compound heavy duty engine; an exciter unit; jet condenser; switchboards; sub-station apparatus, and equipment for 100 arc lamps connected in series. A feature of this installation will be its compactness, as provision has been made for the future enlargement of the plant, when the growth of the city demands it, by an extension of the existing building and the addition of another generating unit.

The Lidgerwood Mfg. Co., 96 Liberty St., New York City, have awarded to the Miller-Collins Co., 1133 Broadway, New York, the general contract for its new plant at Waverly, Newark, N. J. The buildings will cover approximately nine acres when the plant is completely finished, and will cost approximately, $500,000, exclusive of machinery and land. The power house, pattern storage, and foundry will be started immediately. The construction will consist of reinforced concrete, structural steel, and brickwork, with a wood and slag roof over the foundry. The Miller-Collins Co. is in the market for piling, cement, sand, crushed stone, common brick, spruce and pine lumber, windows and sash, doors, skylights, sheet metal work, flooring, structural steel (about 500 tons), tin covered doors, painting, etc. The work has been awarded to the Miller-Collins Co. on its system of a guaranteed cost limit to the owner and lump sum profit to the contractor for its services.

What is said to be the largest contract ever placed for making connections to water mains without shutting off the water, was recently awarded by T. O'C. Sloane, a New York contractor, to the Water Works Equipment Co. of that city. It calls for 360 connections of 6-in. pipe to 20 and 30-in. mains, to be used in locating new hydrants in various parts of the Borough of Brooklyn.

A record in reconstruction has been made by the Riverside Bridge Co., of Wheeling. Its main building was practically destroyed by fire on the morning of Nov. 17, but by Nov. 21 every machine except a large reamer was in operation again. The only damage done to the equipment was to the motors, and that was quickly repaired. The reamer was not needed immediately and its repairs, which will be quickly made, were deferred. The air line has been replaced for the pneumatic tools and hoists, the outside cranes, two hammers and two straightening presses are in service and if the roofing ordered is not delayed the entire works will be in complete winter running order in a few days. A considerable enlargement of the plant is proposed in the spring.

The Anderson & Sons Co., Detroit, is now working 22 hours a day and is advertising in several cities for men skilled in tempering steel, an important part of its work. It has orders for 6,000 automobile crank shafts, 12,000 chisels, and a number of its new concrete mixers, which it has lately been subjecting to very severe tests. It is now installing a grinding machine for fine work on crank shafts.

The Mammoth Copper Mining Co., of Salt Lake City, has just placed an order with the Westinghouse Electric & Manufacturing Co. for a large addition to its electrical equipment. A total of nearly 800 h.-p. in induction motors of different sizes, together with a motor-generator set, transformers, switchboard and three mining locomotives, is included in the order. The motors, two of which have a rated capacity of 200 h.-p. each, and five of 50 h.-p. each, will operate on three-phase, 2,000-volt circuits.

The variety of pumping machinery made by the Allis-Chalmers Co., Milwaukee, is well shown by some of the orders it has closed recently. Mr. Geo. H. Norman, president of the Newport, R. I., Water Co., has ordered a vertical, triple-expansion, crank and flywheel engine with a capacity of 6,000,000 gal. against a head of 190 ft. This will be built after a new design of small vertical engines recently developed by the company. The general contractor for the Massapegna pumping station of the Brooklyn, N. Y., water works, Col. M. J. Dady, has ordered three 10,000,000-gal. centrifugal pumps to be driven by vertical cross-compound engines. The Metropolitan Water & Sewerage Board, of Boston, has ordered for its Arlington station a horizontal compound condensing pumping engine having a capacity of 1,500,000 gal. in 24 hours against a head of 290 ft. This is a new design of small horizontal engine developed to secure good steam economy.

The St. Louis office of the Sullivan Machinery Co., under the charge of Mr. P. F. Jarvis, has been moved to Rooms 1125A-1127, Missouri Trust Building, where the larger quarters will permit more convenient handling of the increasing business of the company in this district.

The Robins Conveying Belt Co. has recently secured from John R. White & Son, of Providence, a contract for hoisting machinery, belt conveyors and cable railways. Among other work now being completed by the Robins Company is the manufacture of belt conveyors for the Blaisdell Co., of Los Angeles, and for the Carvin mines in France.

PERSONAL NOTES.

Mr. P. H. McCrickett has been elected chief engineer of the Oklahoma & Texas R. R., and has begun surveys of the line from Oklahoma City to Wichita Falls, Tex.

Mr. B. H. Hawkins has succeeded Mr. F. W. Williams as master mechanic of the Lackawanna R. R., at Buffalo, N. Y.

Mr. W. H. Wilson has succeeded Mr. E. E. Davis as superintendent of motive power of the Buffalo, Rochester & Pittsburgh Ry., with offices at Du Bois, Pa.

The rumor that Mr. E. J. Buffington is to retire from the presidency of the Illinois Steel Co., has been officially denied.

Mr. B. J. Dalton has been appointed chief engineer of the Denver, Enid & Gulf R. R., succeeding Mr. W. D. Gerber, assigned to other duties.

The title of Mr. W. F. Ackerman, master mechanic, at Havelock, of the Burlington lines west of the Missouri River, has been changed to superintendent of shops.

Prof. John L. Morris, one of the first students at Cornell University and head of its Mechanic Arts Department from its organization until two years ago, died in Ithaca on Nov. 19.

Mr. C. E. Abbott, engineer of the Fayal mine and city engineer of Eveleth, Minn., has resigned both positions to join a zinc mining company in Southern Michigan.

In Nov. 28 Mr. F. W. Patterson will read a paper before the structural section of the Engineers' Society of Western Pennsylvania, on conditions governing county road construction.

The construction work on the Big Four line in the vicinity of Middletown, O., has been put in charge of Mr. P. H. Delano, recently appointed division engineer at that city.

Mr. Charles R. Darrow, formerly president and general manager of the Mahoning Foundry & Machine Co., of Youngstown, has become assistant general manager of the Pennsylvania Engineering Works, New Castle, Pa.

Mr. George Prentiss Robinson, for several years city engineer of Pomona, Cal., has joined the staff of City Engineer H. F. Stofford, of Los Angeles, which is now growing so rapidly that the city engineering work requires about 35 men on office duties and 9 field parties.

Mr. Charles W. Dodge, who has been identified with engineering and contracting interests in New England for the past ten years, has joined the field staff of Dodge & Day, modernizing engineers, and is at present in Chicago, supervising extensive improvements in the plant of the Link Belt Machinery Co.

Thomas J. Long, vice-president of the Atlantic, Gulf & Pacific Co., New York, who died suddenly this week, was one of the most widely known engineers engaged in contracting. He was born in New York in 1852, and was graduated from the Rensselaer Polytechnic Institute in 1873. His first work was on the Atlantic & Great Western R. R., where he remained nearly a year, when he joined the department of docks of New York City. This was congenial work and he served as assistant engineer in the department for twelve years, there acquiring familiarity with timber dock construction. In 1886 he became an assistant engineer of the Morse Bridge Co. at Youngstown, Ohio. Later he represented the Union Bridge Co., mainly in Spanish-American countries, and was associated with R. P. & J. H. Staats, New York, before he bcame connected with the Atlantic, Gulf & Pacific Co .

Mr. G. Fred. Vollmer, for the last four years in Wyoming and Colorado, has opened an office as sewerage specialist and for general engineering practice at Dacre House, Victoria St., Westminster, England. He will make a specalty of representing American engineers who have interests in Great Britain.

Mr. Eugene W. Stern states that he has no connection with the Hay Foundry & Iron Works, as might be implied from a statement in this journal on Oct. 28, at the end of an article on the reconstruction of the Mercantile Building, New York. He made the shop details of the foundation girders, which were fabricated by the Eastern Steel Co., Pottsville, Pa.

William Parkinson, who died in Orange on Nov. 20, was an English mechanical engineer who came to this country in 1869. He worked for a time for Thomas A. Edison, and later with the Maron Watch Co., and the New York Steam Engine Co. He then went to Indianapolis, with the Atlas Steam Engine Co., where he stayed until he returned East to become a partner of Henry W. Bulkley, in the Newark Iron Works. He retired from manufacturing business in 1884 to devote his time to real estate, and became one of the largest property owners in New Jersey.

The following appointments on the South & Western Ry., Lick Creek & Lake Erie Ry., and Carolina Co. have been announced by Mr. M. J. Caples, general manager and chief engineer; Mr. Wm. A. Hankins, principal locating engineer, Bristol, Tenn.; Mr. A. W. Jones, division engineer, Fink, Va.; Mr. William Palmer, division engineer, Clinchport, Va.; Mr. Ward Crosby, division engineer, Lovedale, Tenn.; Mr. Charles L. Ruffin, division engineer, Erwin, Tenn.; Mr. C. O. Vandevanter, division engineer, Spruce Pine, N. C.; S. P. Daniel, division engineer, Rutherfordton, N. C.

Major Cassius E. Gillette, Corps of Engineers, U. S. A., has been appointed chief of the Bureau of Filtration of Philadelphia, succeeding Mr. John W. Hill, who resigned some time ago. Major Gillette is on a special leave of absence, which, it is understood, will be extended in order that he may have ample opportunity to complete the investigations he has in hand. He is the second engineer officer whose services have been borrowed by the city to assist in the affairs of its waterworks, General Ludlow having been his predecessor in such tasks.

At the request of Mr. Robert Hill, chief of the Bureau of Building Inspection, Philadelphia, the following members of the Engineers' Club of that city has been appointed by its president, Mr. Silas Comfort, a committee to co-operate with the Bureau in drawing up building regulations relating to fireproof construction; Messrs. E. G. Perrot, of the architectural firm of Ballinger & Perrot; Henry H. Quinby, assistant engineer, Bureau of Surveys; Charles M. Mills, assistant chief engineer, Philadelphia Rapid Transit Co.; Richard G. Develin, assistant engineer of maintenance of way, Pennsylvania R. R.; Walter Loring Webb, consulting engineer.

Albert J. Pitkin, president of the American Locomotive Co., who died in New York a few days ago, had a career that was most interesting. He was the son of a Presbyterian minister too poor to educate the boy, who went to live with his grandfather in a little Ohio village. In his grandfather's cabinet shop he first showed his peculiar interest and skill in mechanics. He began his apprenticeship when fourteen years old. A year later he entered the locomotive repair shops of the Cleveland, Akron & Columbus Railroad. He became one of the foremost locomotive experts in the country, and won rapid promotion. He was president of the Atlantic Equipment Co., of the Locomotive & Machine Co., of Montreal, of the Locomotive Security Co., the Richmond Locomotive Works and chairman of the board of directors of the Rogers Locomotive Works.

The Hon. Stephen Salisbury, who died at Worcester, Mass., on Nov. 16, was prominently identified with many important industrial enterprises and with technical education, although his influence was so exerted that only those fortunate enough to know him intimately could appreciate the strength of his power when he chose to exert it. Something like twenty years ago, when New England was overrun with wildcat telephone companies, and there was a tendency for the widows and fatherless to invest recklessly in such undertakings, Stephen Salisbury was in a position to control many features of the situation. A group of reckless speculators endeavored to use the sudden enthusiasm for telephones in a get-rich-quick scheme for their own benefit. Salisbury waited until he was sure of the situation, and then gathered these promoters into his strong hands and squeezed out all their reckless ideas. Some of them left the business immediately and others, turning over a new leaf, worked hard and faithfully along the lines Salisbury had laid down. Very few people know how deeply he influenced the telephone business while in its formative period, but these few are outspoken in praise of his important work. The telephone episode is probably the only one in his long and busy career which showed his abilities as a good fighter, for most of his time was spent attending to the details of a large estate mainly invested in land. His grandfather came to Worcester in 1767, and laid the foundations for a large fortune by acquiring the choicest land in what is now the northern part of the city, and this property is to-day one of the most important estates in Massachusetts. Before taking up with his father the burden of its administration, Stephen Salisbury completed the undergraduate and law courses at Harvard, studied at Berlin and Paris, and spent a couple of years in travel. On his return he became interested in banks, railroads, gas and electric undertakings, textile mills and manufacturing companies, and was a director of many of them. He had the old-fashioned ideas concerning the duties of a director, and while he did not often take an active part in suggesting methods of conducting affairs, he rigidly insisted on knowing fully all details of the matters rightfully dependent on the directors' decision. The Worcester Polytechnic Institute ranked next to his own alma mater among a number of educational institutions in which he was interested, and he served many years as one of its trustees, being president of the board when ill health compelled him to resign last summer. He was a frequent and important benefactor of the institute, and his name is held dear by its alumni as a man who, born to great wealth, chose deblierately the "simple life," in the best and deepest sense.

TRADE PUBLICATIONS.

The Crocker-Wheeler Co., Ampere, N. J., has issued in Bulletin 61 a description of the important details of design and construction of its form D machines, both motors and generators. These are belt-type machines of 9 to 225 kw. or 10 to 275-hp. capacity, adapted for general power purposes and small lighting plants. The pamphlet contains very full notes concerning the principal features of the apparatus and tables of the dimensions of the machines of different ratings.

People interested in hollow concrete blocks will find in the numbers of "Cementology," the house organ of the Whitehall Portland Cement Co., Philadelphia, Pa., for October and November, the complete text of the regulations of the City of Philadelphia concerning the manufacture, use and testing of such blocks. These regulations were the subject of long and careful consideration and discussion by interested parties before they were finally adopted and are the most complete yet drawn up.

The Bury Compressor Co., Erie, Pa., successor to the Herron & Bury Mfg. Co., has published a leaflet giving the leading dimensions of a new belt-driven compressor which it has recently designed for small granite works and similar plants.

The steel specialties made by the Don Steel Works, of Hobson, Houghton & Co., Sheffield, England, are described in a 42-page book full of illustrations. Anvils, blacksmiths' tools, files, hammers, drills of many types, saws, chisels and a great variety of steel bars for different kinds of tools are listed.

The Yale & Towne Mfg. Co., 9-15 Murray St., New York, has published an attractively printed brochure on the portable electric hoist which was illustrated in this journal a number of months ago. This hoist is made in four sizes, from 1 to 6 hp. in capacity for use with jibs, cranes and the like, or on trolleys, of which three types are made by the company.

The Crescent system of central station heating is described at length with many illustrations in a book issued by W. H. Pearce & Co., 269 Dearborn St., Chicago, Ill. The underground conduits for both steam and hot-water heating, tunnel construction, overhead construction, manholes, building connections, valves, traps, meters and other apparatus for the purpose, are explained at length.

CONTRACTING NEWS

OF SPECIAL INTEREST TO CONTRACTORS, BUILDERS, ENGINEERS AND MANUFACTURERS OF ENGINEERING AND BUILDING SUPPLIES.

WATER.

Notes Arranged Alphabetically by States.

Monrovia, Cal.—The Bd. of Trade is reported to be considering the question of increasing the city's water supply, and will confer with Engineer Wm. Mulholland, of Los Angeles, with regard to the matter.

Portersville, Cal.—Preliminary plans and estimates have been prepared by C. E. Moore, of Santa Clara, for water works, to cost about $50,000. Construction work will probably not be started for 6 months. Bonds must first be voted.

Wilmington, Del.—See "Bridges."

Washington, D. C.—Gen. Mackenzie, Chief of Engrs., in his annual report, submitted an estimate of $10,000 for preliminary surveys for an additional conduit from Great Falls, to connect with the city water distribution system.

Perry, Fla.—The date of opening of bids for constructing water works has been extended from Nov. 28 to Dec. 5, as advertised in The Engineering Record.

Tifton, Ga.—The citizens are reported to have voted to issue $50,000 bonds for water works, a sewerage system and a school.

'Milledgeville, Ga.—L. J. Wagner, of Rome, is stated to have secured the contract for constructing water works at the State Sanitorium at Milledgeville (bids opened Nov. 15) for $65,000.

Franklin, Idaho.—Wm. A. N. Challis, Village Clk., writes that it is proposed to construct water works at a probable cost of $10,000. Engineer, S. P. Morgan, of Franklin.

Lewiston, Idaho.—The Waha-Lewiston Land & Water Co. has been incorporated with a capital of $2,00,000, by E. D. Thomas, Ralph F. Blanchard, H. K. Barnett and others, all of Lewiston, and F. C. Blanchard, of Newark, N. J.

Chicago, Ill.—In connection with the water works improvements contemplated, it is proposed to install a pump with a daily pumping capacity of 20,000,000 gals. at the 68th St. pumping station; another with a capacity of 40,000,000 gals. at the Chicago Ave. pumping station and a third with 40,000,000 gals, capacity at the Central Park Ave. station.

Lovington, Ill.—Bids will be received until Dec. 15 by the Village Bd. for a 60,000-gal. steel water tank erected on steel tower having a total height of not less than 110 ft.; bids to include foundations, riser pipe, frost casing and 100 ft. of 8-in. water main laid. Bidder may submit plans if desired. M. A. Earl, Engr., 1416 First Natl. Bank Bldg., Chicago.

Chicago, Ill.—Bids will be received until Dec. 1 by the Bd. Local Improv. (John A. May, Secy.) for laying water supply pipes in several streets.

*East Moline, Ill.—The following are the bids opened on Nov. 13th for constructing complete a system of water works, to consist of a 100,000-gal. steel standpipe; brick pump house; concrete reservoir; two pumping units, consisting of two 14-hp. engines direct connected to the pumps; 17,980 lin. ft. c.-i. mains, 6, 8 and 10 in.; 30 double hydrants and about 20 gate valves. (Engineers, Kimball Eng. Co., Davenport, Ia.): G. W. Meridith, Cedar Rapids, Ia., $37,000; W. H. Dearborn, Stone City, Ia., $38,900; Dwyer Htg. & Plumbing Co., St. Paul, Minn., $36,465; Moline Htg. & Constr. Co., Moline, Ill., $30,895, and Des Moines Bridge & Iron Works, Des Moines, Ia., $29,100 (recommended for award).

Lincoln Center, Kan.—See "Power Plants, Gas and Electricity."

*Indenpdence, Kan.—The following are the bids opened Nov. 15 for furnishing material and installing a mechanical filtration plant in three units of 500,000 gal. daily capacity each. (Engineers, Burns & McDonnell, Kansas City, Mo.): Greer Filter Co., Philadelphia, Pa., $3,486 (awarded contract); Roberts Mfg. Co., Pittsburg, Pa., $3,975; Jackson Filter Co., St. Louis, Mo., $4,250; W. B. Scaife & Sons, Pittsburg, Pa., $4,500; C. L. Dean, Minneapolis, Minn., $4,940; Pittsburg Filter Co., Pittsburg, Pa., $5,500; Federal Filtration Co., New York, N. Y., $5,857.

Marksville, La.—See "Power Plants, Gas and Electricity."

Abbeville, La.—See "Power Plants, Gas and Electricity.'"

West Springfield, Mass.—Specifications are being prepared for filtration and pumping plant for the water works, to cost about $40,000. Engineer, C. M. Woodward, West Springfield.

*Detroit, Mich.—Wickes Bros., of Saginaw, are reported to have secured the contract for 3 water tube boilers for $8,350; also for stokers at $4,089.

St. Paul, Minn.—The Water Bd. is stated to have approved applications for 26,170 ft. 6-in., 5,880 ft. 12-in. and 1,000 ft. 16-in. water mains. Construction will begin next year.

Shelby, Miss.—Bids will be received until Dec. 5 by the Mayor and Bd. Aldermen for $25,000 bonds for constructing water works and a sewerage system. J. R. Murnan, Mayor.

Hattiesburg, Miss.—The City Council is stated to have decided to issue bonds for permanent public improvements during the year, as follows: street improvements, $155,000, water works improvements $30,000, and sewers $15,000.

Springfield, Mo.—A committee is investigating cost, etc., with a view to purchasing the plant of the Springfield Water Co. G. W. Hackney, City Clk.

Huntley, Mont.—Plans and specifications are on file at the office of The Engineering Record, 114 Liberty St., New York, N. Y., for the construction of main canal, lateral and ditches, also a telephone system, to be known as the Huntley project, bids for which will be received at the office of the Engineer, U. S. Reclamation Service, Billings, Mont., until Dec. 15, both proposals for which are advertised in The Engineering Record.

Goldfield, Nev.—Frank M. Ish, John S. Cook, Chas. F. Pugh and others, who propose constructing a private sewer system here, are also reported to have obtained a franchise to pipe water into Goldfield from the Highland Mine at Diamondfield. They have completed arrangements with the Town Council by which the city will pay half the cost of laying the pipes. A reservoir will be built on Colummbia Mountain, and a high-pressure gravity system will be used.

Plainfield, N. J.—The citizens are reported to have voted in favor of municipal ownership of the water works.

New York, N. Y.—Bids will be received until Nov. 29 by John T. Oakley, Comr. Water Supply, Gas and Electricity, for furnishing, delivering and laying water mains in 13 streets, Boros. Manhattan and Bronx.

*Buffalo, N. Y.—The following are reported to be the bids opened on Nov. 3 by the Comrs. of Pub. Wks. for furnishing material and erecting complete one radial brick chimney, 250 ft. high, and 11 ft. internal diam., at pumping station: M. W. Kellogg Co., $18,543 (awarded contract); Henry P. Burgard, $19,850; H. R. Heinicke, Inc., $19,875; B. I. Crooker, $21,200; Alphons Custodis Chimney Constr. Co., $21,537.

Mandan, N. D.—P. H. Michaels & Co., Mansfield, O., are stated to have petitioned for a franchise for water works.

Hope, N. D.—See "Power Plants, Gas and Electricity."

East Liverpool, O.—See "Power Plants, Gas and Electricity."

*Cincinnati, O.—The Comrs. of Water Wks. are stated to have on Nov. 17 awarded to the Riter-Conley Mfg. Co., Pittsburg, Pa., the contract for furnishing steel pipe for the filtration plant at $42,132.

Tecumseh, Okla. Ter.—A petition is being circulated here asking the Mayor and Council to submit to the voters a proposition to issue $50,000 bonds for water works.

Woodward, Okla. Ter.—M. Griffin O'Neil, of Dallas, Tex., Pres. O'Neil Eng. Co., writes that this company proposes constructing water works at Woodward. Bids will be called for about Feb. 1.

Salem, Ore.—See "Power Plants, Gas and Electricity."

Baker City, Ore.—The Baker Irrigation Co. is stated to have decided to construct an irrigation ditch about 16 miles in length, commencing about 6 miles south of Baker City, tapping Powder River. A reservoir will be constructed on Big Flat.

Klamath Falls, Ore.—Plans and specifications are on file at the office of The Engineering Record, 114 Liberty St., New York, N. Y., for the construction of 9 miles of main canal near Klamath Falls, with headworks, sluice gates, bridges, etc., bids for which will be received until Dec. 29 at the office of the Engineer, U. S. Reclamation Service, Merchants Exchange Bldg., San Francisco, Cal., as advertised in The Engineering Record.

*Sharon, Pa.—The contract to build the dam for the Mahonong Valley Water Co.'s reservoir in Yellow Creek, south of Struthers, is reported to have been awarded to William McIntyre & Sons, of Sharon. It will be 300 ft. long, 45 ft. thick at the base, 16 ft. at top and 68 ft. high. The cost of the construction willl be about $100,000. The dam will back up a lake with a surface of 100 acres and the volume of water that is expected to be available is estimated at 700,000 gals.

*Providence, R. I.—The Warren Foundry & Machine Co., of New York, N. Y., has secured the contract for furnishing and delivering about 6,803 tons of c. i. pipe, 4, 6, 8, 12, 16, 24, 30 and 42-in. diam., at $26.40 per net ton; total cost, $201,151. The bids for this work were opened on Nov. 16 by the Comrs. of Pub. Wks. (Herbert E. Wood, Secy.).

Grand Saline, Tex.—The State Attorney-General is stated to have approved an issue of $14,500 water works bonds.

Salt Lake City, Utah.—Bids will be received until Dec. 10 (readvertisement) by the Bd. Pub. Wks. (C. A. Wall, Chmn.) for constructing a brick and concrete conduit to replace a portion of the Jordan and Salt Lake City Canal. Approximate quantities of work to be done are as follows: 2,000 cu. yds. excav. and backfill; removing wooden flume, 2,400 lin. ft.; 2,000 lin. ft. brick conduit; 1,000 lin. ft. concrete conduit; 1,000 lin. ft. 8-in. pipe and 6 manholes.

Portsmouth, Va.—The Portsmouth, Berkeley & Suffolk Water Co. is reported to be considering the question of installing a filtration plant.

Granite Falls, Wash.—W. H. Earl is reported to have petitioned for a franchise for water works.

Prescott, Wash.—Chas. H. O'Neil, Town Clk., writes that bids for construction of the proposed water works will be received about Dec. 20; probable cost, $5,500.

Parkersburg, W. Va.—G. L. McKibben, of Van Wert, O., is the engineer who will have charge of the construction of the proposed municipal water works for Parkersburg; probable cost of work, $195,000. Water suply is being developed. Date for receiving bids for construction not yet set.

Casper, Wyo.—J. B. Bradley, of Casper, is engineer in charge of constructing a reservoir at Two Bar ranch on Bates Creek, in which John Mahoney, of Rawlins, is interested. Work will probably not be let by contract.

Encampment, Wyo.—J. A. Whiting, of Encampment, is reported to be engineer in charge of the proposed irrigation system of the North Platte & Encampment Canal Co.

Winnipeg, Man.—H. H. Ruttan, City Engr., writes that all bids opened Nov. 6 for a steel caisson, 15 ft. diam. and 43 ft. deep for a new well for additional water supply, have been rejected and new bids will be received unti 3:30 P. M., Nov. 27.

Dundas, Ont.—Dr. Hodgetts and Dr. Amyott, in a report to Council on the extension of the water supply, are stated to have recommended a system of filtration for either the Dundas Creek, or the water from the canal basin.

*Toronto, Ont.—Thos. McQueen, Secy. Bd. of Control, writes that contracts for alterations and additions to the High Level Pumping Station have been awarded as follows (bids opened Nov. 7): Masonry, H. Lucas & Son, $15,624; carpenter work, Peter Arnot, $3,667; iron and steel work, The Locomotive & Machine Co., of Montreal, Que., $2,300; painting and glazing, R. J. Hovenden, $637; roofing, R. Gilday, $600, and sheet metal, Wheeler & Bain, $1,256.

Port Stanley, Ont.—Jas. A. Bell is stated to have completed his report for installing water works in this village, in which he recommends that the source of supply be taken from the beach in front of Fraser Hill. He proposes erecting a pump house at foot of hill to contain a boiler of 50 hp. and a duplex pump, capable of pumping 350 gal. per minute; also a stand-pipe 50 ft. high, 16 ft. diam., with a capacity of 60,000 gals.

Panama.—Bids will be received by the Isthmian Canal Comn., Washington, D. C., until Dec. 8, for iron pipe and fittings, pig lead, cement, portable forges, wire screening, etc., as advertised in The Engineering Record.

SEWERAGE AND SEWAGE DISPOSAL.

Notes Arranged Alphabetically by States.

Douglas, Ariz.—The City Clerk writes that Frank A. Olmsted, of Los Angles, Cal., has prepared plans and will supervise the construction of the proposed sewerage system if bonds are issued; estimated cost, $65,000.

Fresno, Cal.—W. H. Ryan, City Clk., writes that no date has yet been set for receiving bids for the proposed improvements to the sewerage system; probable cost, $175,000. Engineer, Geo. L. Hoxie.

Visalia, Cal.—Morve L. Weaver, City Engr., writes that an election will be held Dec. 7 to vote on issuing $15,000 bonds to rebuild or repair the present outfall sewer.

Denver, Colo.—Local press reports state that a new sewer district embracing Montclair and the eastern part of Capitol Hill will be created by the Bd. of Public Wks. next year, to cost about $70,000.

Milledgeville, Ga.—Chas. L. Moore, City Clk., writes that the citizens voted Nov. 9 to issue $20,000 bonds for the construction of a sewerage system.

Tifton, Ga.—See "Water."

Chicago, Ill.—Bids will be received until Dec. 1 by the Bd. Local Improv. (John A. May, Secy.) for laying 6-in. drains in numerous streets.

Libertyville, Ill.—Bids will probably be received about Feb. 1 for the construction of 3 miles of 8 to 15-in. pipe sewers and a septic tank; probable cost, $25,000. Engineer, Jas. Anderson, Jr., Lake Forest, Ill.

Lake Forest, Ill.—Bids will probably be received in February for the construction of 2 miles of pipe sewers; probable cost, $10,000. Engineer, Jas. Anderson, Jr., of Lake Forest.

Highland Park, Ill.,—James Anderson, Jr., of Lake Forest, is engineer for the construction of about 2 miles of pipe sewers for Highland Park, bids for which will probably be received in February; probable cost, $15,000.

Princeton, Ind.—Henry H. Niekamp, City Engr., writes that Edwyn E. Watts, of Princeton, has been selected to prepare plans and specifications for the construction of a sewerage system. Bids for construction will be received Feb. 15.

Ida Grove, Ia.—Prof. A. Marston, of Ames, is stated to have completed plans for a sewerage system for Ida Grove, which he estimates will cost about $35,000.

Clear Lake, Ia.—There is some talk of constructing a sewerage system here.

Abbeville, La.—See "Power Plants, Gas and Electricity."

Boston, Mass.—Bids will be received until Dec. 16 by Mordecai T. Endicott, Ch. Bureau Yards and Docks, Navy Dept., Washington, D. C., for vitrified pipe sewers and drains and accessories, at the Navy Yard, Boston.

The following are reported to be the bids opened Nov. 13 for constructing Section 4 of the Dorchester High Level Sewer at Dorchester: D. E. Lynch, $23,875; Jas. D. Fallon, $21,580; F. A. Foster & Co., $19,781; W. J. Barry, $19,612; D. F. O'Connell Co., $17,259; T. J. O'Connell, $16,463; J. A. Rooney, $16,455; P. H. Hill, $16,293; W. B. Bryne, Medford, $15,238.

The lowest bid opened Nov. 17 for sewerage work in Prescott St., East Boston, was submitted by T. J. O'Connell, of Dorchester, for $3,143.

Delray, Mich.—The only bid received and opened on Nov. 15 by the Village Council for constructing sewers from Crawford Ave. to Louis Ave. and from River St. to the village limits was submitted by Sheahan & Co. for $24,860.

*Grand Rapids, Mich.—The contract for constructing a sewer in Adams St., from Madison Ave. to East St., is stated to have been awarded to Fred Gilner for $9,740.

Morris, Minn.—L. C. Spooner is reported to be chairman of the committee which is considering the matter of securing a sewerage system.

Shelby, Miss.—See "Water."

Hattiesburg, Miss.—See "Water."

Goldfield, Nev.—See "Water."

Bradley Beach, N. J.—W. E. Macdonald, Boro. Clk., writes that bids will be received Nov. 27 for the construction of 450 ft. of sewer complete.

Syracuse, N. Y.—Bids will be received until Nov. 27 by the Bd. Contract and Supply, for furnishing material and constructing an 8-in. pipe sewer in Burdick and Murray Aves. Geo. J. Metz, City Clk.

Brooklyn, N. Y.—The following are reported to be the totals of bids opened on Nov. 15 by Martin W. Littleton, Pres. Brooklyn Boro., for furnishing material and constructing sewer in Quay St., from East River to West St., etc. Bids were taken on three estimates, as follows: (a) Estimate A; (b) Estimate B; (c) Estimate C (bidders all of Brooklyn): Newman Constr. Co., a $107,924; b $110,783; c $109,830. W. P. McGarry, a $122,348; b $119,516; c $123,927. Jas. Malloy & Co., a $94,332; b $96,238; c $92,426. Jas. H. Holmes a $99,969; b $97,-

**Items marked thus give the names of parties awarded contracts.*

630; *c* $102,741. John J. Creem, *a* and *b*, $124,149; *c* $120,857. Donlan Constr. Co., *a* and *b* $124,691; *c* $120,164.

**Long Island City, L. I., N. Y.*—The Uvalde Asphalt Paving Co., 26 Court St., Brooklyn, has just secured the contract for constructing sewers and sewage disposal plant at Flushing, Queens Boro., bids opened on Aug. 31, by Jos. Cassidy, Pres. Queens Boro., for $274,500. For list of bids in detail received for this work, see issue of The Engineering Record Sept. 9.

**Columbus, O.*—Miles, Murphy & Sullivan, of Columbus, are reported to have secured the contract for constructing the sewage disposal plant (bids opened Nov. 2 by the Bd. of Pub. Service) for about $435,000.

Akron, O.—City Engr. Payne estimates the cost of constructing a brick conduit along Bartges St. and Mallison Ave. and a sewer from a culvert in Wooster Ave. to East Ave., at a total cost of $8,305.

It is stated that bids will be received until Nov. 28 by the Bd. Pub. Service (Chas. H. Watters, Secy.) for constructing a 4-ft. storm water sewer in portions of Voris, Miami and Thornton Sts.

Cincinnati, O.—Bids will be received until Nov. 28 by the Bd. Pub. Service (Geo. F. Holmes, Clk.) for furnishing material and improving a portion of Omaha St., by constructing sewers and drains.

South Brooklyn (Brooklyn P. O.) O.—It is stated that bids will be received until Dec. 11 by W. T. Pupikofer, Village Clk., for constructing sewers in Franklindale and Lindale Aves.

Toledo, O.—This city is reported to have in contemplation new sewerage for Districts Nos. 41 and 42.

Erie, Pa.—Local press reports state that bids will shortly be asked for the construction of an improved sewerage system in the 6th Ward.

Carlisle, Pa.—At the February election the citizens will probably be asked to vote on issuing bonds for the construction of sewers.

Lansford, Pa.—The citizens are reported to have voted to issue $25,000 bonds for the construction of sewers.

Harrisburg, Pa.—Bids will be received until Nov. 29 by the Highway Dept. (W. H. Lynch, Comr.) for constructing sewers in Salmon, Elizabeth and 2d Sts.

**Aberdeen, S. D.*—F. W. Raymond, City Aud., writes that Jones & Roderick have secured the contract for constructing sewers on Walnut Ave. and 1st Sts., for $5,411.

The Council Com. is visiting cities which have sewage disposal plants, with a view to installing one here in the near future.

Springfield, Tenn.—The Springfield Sewerage Co. is reported incorporated, with a capital of $4,000, by H. T. Stratton, Jr., J. W. Bell, H. H. Mason and others, to construct a system of sewerage.

Brenham, Tex.—Wm. Lusk, Mayor, writes that it is proposed to expend $3,500 for new pipe sewers at once.

Seattle, Wash.—Asst. City Engr. Dimock is stated to have completed plans for the construction of a trunk outfall sewer in the northern section of the city; it will be 10 miles in length and cost about $1,500,000.

Milwaukee, Wis.—The City Council on Nov. 13 passed an ordinance, providing for the issue of $100,000 sewer bonds, $200,000 for street improvements and $100,000 for docking and dredging.

BRIDGES.

Notes Arranged Alphabetically by States.

**Ft. Smith, Ark.*—The Virginia Bridge Co., of Roanoke, Va., is stated to have secured the contract for constructing a viaduct over the Iron Mountain R. R. tracks for $36,650. Other bidders on the structure were as follows: The Missouri Bridge & Iron Co., $36,950; the Texas Bridge Co., $38,025 and the Midland Bridge Co., $39,000.

Wilmington, Del.—The Water Dept. (Theo. A. Leisen, Ch. Engr.) is preparing plans for a reinforced concrete bridge 335 ft. long and 24 ft. wide, to be constructed across Brandywine Creek at Van Buren St., for the purpose of carrying a 48-in. distributing main. It will have 3 spans 56 ft. and 4 spans 28 ft.

**Urbana, Ill.*—T. O. Burt, County Clk., writes that the contract for constructing the supstructure of 140 ft. highway bridge (bids opened Nov. 15) has been awarded to Burnham & Ives, of Bloomington, for $3,573.

Chicago, Ill.—The Engineering Com. of the Drainage Bd. is stated to have recommended the award of the contract for the erection of a new bascule bridge at Dearborn St. as follows: Substructure, Great Lakes Dredging & Dock Co., $142,253; superstructure, Jackson & Corbett Bridge & Iron Co., $145,335.

**Indianapolis, Ind.*—The Bd. of County Comrs. is stated to have awarded the contract for constructing a bridge over Fall Creek at 30th St., to Wm. Fife & Son, Majestic Bldg., for $74,800.

Huntington, Ind.—It is reported that bids will be received until Dec. 4 by the Co. Comrs. for constructing a 2-span bridge across Wabash River at White Church, total length to be 205 ft., and also a 2-span bridge, 210 ft. total length, across Wabash River at Mt. Etna. Bids on both bridges to be for a concrete or an iron structure. It is reported that bids will be received at same time and place for constructing a 100-ft. span bridge known as Ginger Hill bridge, the appropriation for this bridge being $2,500.

Wichita, Kan.—It is stated that bids will be received until Dec. 2 by the Co. Comrs. for constructing 4 steel bridges.

Springfield, Mass.—The folowing bids are stated to have been opened on Nov. 15 by the Bd. Co. Comrs. for furnishing material and laying a wooden floor system upon the bridge over the Connecticut River, between Chicopee and West Springfield: L. S. Woods, of Springfield, $14,225; D. O'Connell Sons Co., of Holyoke, $14,537; R. F. Hawkins Iron Wks. Co., of Springfield, $13,375; United States Wood Preserving Co., of New York, N. Y., $18,205, and Rivers & Young, of Chicopee (2 bids), $14,025 and $18,660.

Port Huron, Mich.—It is probable that bids will soon be asked for the construction of a bridge across Black River at Military St.

Gulfport, Miss.—It is stated that bids will be received until Dec. 4 by the Bd. of Superv. for constructing a bridge across Red Creek.

**Indianola, Miss.*—The contract for constructing a steel bridge in Indianola is reported to have been awarded to the Bellefontaine Bridge & Iron Co., of Bellefontaine, O., for $6,000.

Carthage, Mo.—It is stated that bids will be received until Nov. 30 by Wm. Kohlman, Co. Surv., for constructing 2 steel bridges.

Great Falls, Mont.—The Bd. of County Comrs. are reported to be considering the construction of a bridge over the Missouri River at or near Ulm.

Perth Amboy, N. J.—Later reports state that all bids received for constructing the approach to the Amboy Bridge have been rejected and, according to reports, new bids will be received.

Harrison, N. J.—See "Railroads."

Atlantic City, N. J.—"See Miscellaneous."

Camden, N. J.—It is stated that all bids opened Oct. 30 by the Bd. of Freeholders for constructing a bridge over Coopers Creek have been rejected and, according to reports, new bids will be received.

New York, N. Y.—Justice Dowling of the Supreme Court, on Nov. 21, granted an injunction restraining the Comr. of Bridge and the city authorities from awarding the contract for the superstructure of the Manhattan Bridge to the Pennsylvania Steel Co. The bids for this work were opened on Aug. 10.

New York, N. Y.—The Bd. of Estimate and Apportionment adopted a resolution authorizing the issue of $1,000,000 corporate stock, for the purpose of providing means for the acquisition of lands required for the bridge over the East River, between the boroughs of Manhattan and Brooklyn, known as Manhattan Bridge (No. 3), and for the necessary expenses connected with the construction of said bridge.

Toledo, O.—The Council Com. on Pub. Improvements is stated to have approved of the proposed extension of Superior St. over Swan Creek, which include the construction of a bridge to cost $22,000.

Sioux Falls, S. D.—Bids will be received until Dec. 8 by C. E. Hill, Co. Aud., for furnishing material and constructing all bridges that may be ordered by the Bd. Co. Comrs. during the year 1906.

Milwaukee, Wis.—Bids will be received until Dec. 15 by the Bd. Pub. Wks. (Chas. J. Poetsch, Chmn.) for constructing Sec. No. 1 of the superstructure of Washington Ave. viaduct (so called).

**Portage, Wis.*—The contract for constructing the superstructure of a steel highway bridge over Wisconsin River consisting of 4 spans of 160 ft. with a 24-ft. brick roadway, is reported to have been awarded to the Pan-American Bridge Co., of New Castle, Ind., for $29,292.

Montevideo, Uruguay.—The Government of this country has appropriated $3,102,000, American gold, to be used in the construction of public roads and bridges, and the improvement of harbors and rivers in the interior. It desires to buy bridge material and road-making machinery. John W. O'Hara, American Consul.

PAVING AND ROADMAKING.

Notes Arranged Alphabetically by States.

Birmingham, Ala.—The City Council is stated to have passed an ordinance providing for the paving with bituminous macadam of a portion of 1st Ave.

*The contract for paving with bituminous macadam a portion of Highland Ave. is reported to have been awarded to the Southern Bitulithic Co. for $29,745.

Little Rock, Ark.—The estimated cost of paving with brick a portion of Main St. is reported to be $33,000.

**Bisbee, Ariz.*—C. W. Hicks, City Clk., writes that the contract for 3,600 sq. yds. brick pavt. on Main St. and Brewery Ave. (bids opened Nov. 7) has been awarded to F. O. Brown, of Dallas, Tex.

Live Oak, Fla.—It is stated that bids will be received until Dec. 8 by the Bd. Co. Comrs. (Mr. Humphries, Chmn.) for constructing 40 miles of hard road throughout the different sections of the county; bids to be submitted on entire mileage and also on any separate parts of it.

**Ft. Oglethorpe, Ga.*—Capt. C. Nixon, Q. M., U. S. A., writes that the contract for paving driveways in 9 stables at this post has been awarded to C. H. Pittman, of Atlanta; total of 3,514 sq. yds.

**Martinsville, Ind.*—The contract for constructing about 25½ miles of gravel road in Clay Township is reported to have been awarded to the following for $24,482: Jesse & Matthew Monical, Harvey Kirk, John Dolen and Wallace Pointer, all of Clay Township.

**Ft. Madison, Ia.*—The contract for grading and macadamizing has been awarded to McManus & Tucker, of Keokuk, and the contract for curbing has been let to Geo. H. Schaeffer, of Ft. Madison (bids opened Nov. 13). The following are the bids received for this work: (*a*) McManus & Tucker, Keokuk; (*b*) Alexander & Gillette, Minneapolis, Minn.; (*c*) Geo. H. Schaffer, Ft. Madison; (*d*) Stephen Schulte, Ft. Madison; (*e*) F. J. Hansman, Ft. Madison; (*f*) Stellern & Co., (*g*) John Downes, Ft. Madison:

	Excav. 16,000 cu. yds.	Macadam pavt. 31,000 sq. yds.	Cement curb 16,200 lin. ft.	Total.
a	$.33	$.49	$.29	$25,068
b	.34	.52	.31	26,582
c	.39	.54	.259	27,176
d	.38	.68	.36	32,992
e	.35	.77	.28	34,006
f	.36	.88	.28	37,576
g	..	..	.297	.. ..

Portland, Me.—Bids will be received by the Committee on Public Works (Edw. M. Hunt, Secy.) until Dec. 1 for furnishing a stone crushing plant, consisting of a stone crusher, elevator, screen, engine and boiler, as advertised in The Engineering Record.

**Leominster, Mass.*—The following are the bids opened on Nov. 16 by the State Highway Comn., Boston, for resurfacing a section of State highway about 9,100 ft. in Leominster: Bruno & Milano, Boston, $6,544; Worcester Broken Stone Co., Worcester, $5,307; R. F. Hudson, Melrose, $5,135; O. T. Benedict, Pittsfield, $5,106 (awarded contract).

Hattiesburg, Miss.—See "Water."

**Atlantic City, N. J.*—The contract for paving 93,000 sq. yds. with asphalt and 12,000 sq. yds. with vitrified fire clay block on Atlantic Ave. is reported to have been awarded to the Cleveland Trinidad Paving Co., of Cleveland, O., for $259,310.

Albany, N. Y.—The citizens of the State of New York are reported to have voted in favor of amending the constitution authorizing the State to borrow $50,000,000 for the improvement of highways under the Higbie-Armstrong act. The act provides for macadam pavement under plans submitted by the State Engr.

New York, N. Y.—Bids will be received until Dec. 4 by John F. Ahearn, Boro. Pres., for constructing parkways on Delancey St., from Bowery to Norfolk St. Engineer's estimate: 19,572 sq. ft. of walk pavt. of rock asphalt mastic, with concrete base and rubble stone foundation, including all excavation and regulation of bed for same; 200 cu. yds. earth excav.; 3,028 lin. ft. wrought-iron picket fence 3½ ft. high, inclosing park, as shown on detail plan, including excavation, concrete bases, bracing and painting; 3,759 lin. ft. new curb furnished and set, etc.

Syracuse, N. Y.—Bids will be received until Nov. 27 by the Bd. Contract and Supply for furnishing material and paving a portion of Leavenworth Ave. with Hallwood, Mack, Johnsonburg, Pittsburg, Buffalo, Shawmut or Syracuse brick of standard grade or quality; also Highland St. with natural asphalt sheet pavt. Geo. J. Metz, City Clk.

Cincinnati, O.—Bids will be received until Dec. 12 by the Bd. Pub. Service (Geo. F. Holmes, Clk.) for furnishing material, grading, curbing and paving a portion of Spring Grove Ave. with bitulithic. Also a portion of Chatham St. with brick.

Sandusky, O.—Bids will be received until Dec. 18 at the office of Alex. M. Wagner, City Aud., for $54,000 bonds for paving Camp and 1st Sts. and Washington Row.

Toledo, O.—See "Bridges."

Columbus, O.—Bids will be received until Nov. 28 by the Bd. Pub. Service (Chas. H. Frank, Secy.) for repaving portions of several streets.

Delaware, O.—Paving bonds amounting to $10,000 are reported sold.

**Seattle, Wash.*—Bids were opened on Nov. 4 by the Bd. of Pub. Wks. for paving King and other streets with (*a*) granite block, (*b*) basalt block, (*c*) sandstone or (*d*) brick. Stirrat & Goetz, 602 Bailey Bldg., secured the contract for the paving, using portions of each material. The following are the totals of bids recieved: Sparger Concrete Co., Colman Blk., *a* $51,910, *b* $53,432, *c* $47,342, *d* $40,237; Stirrat & Goetz, *a* $48,853, *b* $49,853, *c* $47,316, *d* $38,688; Bell & Price, Marion Bldg., *a* $54,495, *b* $51,754, *c* $48,405, *d* $43,837; F. McLellan, 435 Burke Bldg., *a* $54,415, *b* $55,430, *c* $49,340, *d* $44,163; Barber Asphalt Pav. Co., 619 Bailey Bldg., *a* $53,478, *b* $52,463, *c* $52,970, *d* $42,313. The successful bidder, Stirrat & Goetz, bid for the paving, 10,500 sq. yds., $3.35 for granite or basalt block; $3.10 for sandstone and $2.25 for brick; 10,000 cu. yds. sub grading, 10 cts; 2,150 lin. ft. straight granite curb, $1.15; 120 lin. ft. curved granite curb, $1.50.

Bids will be received until Dec. 2 by C. B. Bagley, Secy. Bd. Pub. Wks., for paving Prefontaine Pl. and other streets by laying vitr. brick and sand stone block pavt.; est. cost, $105,000.

Bayonne, N. J.—F. W. Dalrymple, City Engr., writes that the following are the bids opened on Nov. 21 for an asphalt pavement: (*a*) Barber Asphalt Paving Co. (solidad asphalt); (*b*) Uvalde Asphalt Paving Co. (Venezuela Lake asphalt); (*c*) Barber Asphalt Paving Co., (Trinidad pitch asphalt); (*d*) Warner-Quinlan Asphalt Co. (Trinidad, Cuban or Bermudez); (*e*) Lee & MacDonald (Bermudez Lake asphalt):

	a	*b*	*c*	*d*	*e*
10,100 cu. yds. excavation	$.38	$.32	$.38	$.30	$.45
27,700 sq. yds. asphalt paving on 4-in. concrete base	1.49½	1.52	1.59½	1.69	1.58
6,640 lin. ft. stone curb reset	.10	.10	.10	.05	.14
250 lin. ft. new concrete curb	.59	.60	.59	.60	.75
2,790 lin. ft. concrete curb and gutter	.90	.95	.90	.75	1.05
250 lin. ft. new stone curb	.65	.67	.65	.60	.69
1,100 sq. ft. flag walks relaid	.02¾	.02	.02¾	.03	.04
6,680 sq. ft. bridge stone taken up and stored	.05	.05	.05	.03	.07
4,760 sq. ft. bridge stone taken up and relaid	.07	.07	.07	.05	.06
11 sets new circular curb corners	10.00	10.00	10.00	7.00	11.00
4 receiving basin heads reset	5.00	5.00	5.00	2.00	5.00
Totals	$49,562	$49,783	$52,332	$53,124	$53,460

Paoli, Ind.—It is reported that bids will be received until Dec. 6 by the Bd. Co. Comrs. (Geo. R. Cadle, Chmn.) for constructing about 5,280 ft. of the Orangeville Township gravel road.

**Bartlesville, Ind. Ter.*—W. A. Stuckey Constr. Co., of Coffeyville, is reported to have secured the contract for paving with brick a portion of 2d St., at $1.75 per sq. yds.

Wheeling, W. Va.—The Suburban Co. is reported to have submitted the lowest bid for paving with brick on 6th St., their bid being $4,563.

Milwaukee, Wis.—See "Sewerage and Sewage Disposal."

Ponce, Porto Rico.—Bids will be received until Dec. 4 at the Pub. Wks. Office (Louis P. Valdivieso, Mayor)

**Items marked thus give the names of parties awarded contracts.*

for a steam road roller to be used to macadamize the city of Ponce. Information may be had by applying to J. M. Ceballos & Co., 27 William St., New York, N. Y.

Montevideo, Uruguay.—See "Bridges."

POWER PLANTS, GAS AND ELECTRICITY.

Notes Arranged Alphabetically by States.

Pocahontas, Ark.—S. C. Dowell, of Walnut Ridge, is reported interested in the construction of an electric light plant for Pocahontas, to cost $25,000.

Vallejo, Cal.—The citizens are reported to have petitioned the Bd. of Trus. to call an election to vote on issuing about $70,000 bonds for a municipal electric light plant.

Red Bluff, Cal.—The Northern California Power Co. (E. V. D. Johnson, Mgr., Redding) is stated to have decided to build an electric power line from the Volta power plant near Shingletown to Red Bluff or Tehama.

Rio Vista, Cal.—J. S. McDonald, of San Francisco, Cal., representing the Rio Vista Electric Light & Power Co., is stated to have petitioned the Town Trus. for a franchise to erect poles; also for the lease of certain property on which the company proposes constructing a power plant. This company has been incorporated with a capital of $25,000. Directors: J. A. Flood, of Bakersfield; R. Barks and H. S. Richmond, of Coalinga.

Las Animas, Colo.—The Las Animas Electric Light Co. (D. Kennedy, Gen. Mgr.) is reported to have decided to enlarge its plant.

Wilmington, Del.—It is stated that plans have been completed and work will probably commence in the spring on the power house of the Wilmington Light, Heat & Power Co.

Washington, D. C.—Bids will be received at the Bureau Supplies and Accounts, Navy Dept., Washington, D. C., until Dec. 5, to furnish at the navy yards, etc., Portsmouth, N. H.; Boston, Mass.; New York, N. Y.; League Island, Pa.; Washington, D. C., and Norfolk, Va., a quantity of naval supplies, as follows: Schedule 238, arc lamps; Portland cement; sand; lumber; iron pipe and fittings; radiators. Schedule 239, incandescent lamps; electrical wire; Franklin portable crane; bar steel, etc. Schedule 241, indicating fuses; coil heaters; chain hoists; rivet forges; brass; sheet copper; galvanized sheet steel, etc. Schedule 242, shaft hangers; steel bars; sheets and angles, etc. Applications for proposals should designate the schedule desired by number. H. T. B. Harris, Paymaster Gen'l., U. S. N.

Atlanta, Ga.—The Southern Light & Power Co. has petitioned Council for a franchise. It is stated that it will get its current from the plant of the North Georgia Electric Co., at Gainesville, and transmit it to Atlanta through heavily insulated wires supported by steel towers 45 ft. high.

Columbus, Ga.—The Lighting Committe of Council (L. Jones, Chmn.) has been asked to investigate the cost of a municipal lighting plant.

Ft. McPherson, Ga.—Bids will be received until Dec. 1 by Capt. B. B. Buck, Constr. Q. M., U. S. A., for furnishing and installing electric light fixtures and making service connections between secondary and main line switches at Ft. McPherson.

Sparta, Ga.—It is stated that bids will be received until Dec. 7 for furnishing material and installing a complete electric light plant, embracing a 66-in. x 18-ft. high-pressure boiler and stack; a 100-kw. a. c. generator unit, either for belted connections to Corliss engine or direct connection to automatic engine; 9 arcs and forty 50-cp. series incandescents; 800 light transformers and meter capacity and pole line. R. W. Moore, Mayor; J. B. McCrary, Engr., Senoia.

Chicago, Ill.—Bids will be received until Dec. 1 by the Bd. of Dirs. of the Chicago Pub. Library (W. B. Wickersham, Secy.) for a gas or oil engine and dynamo.

Zionsville, Ind.—M. E. Wieseham, Mgr. Zionsville Water & Electric Light Co., writes that his company will construct an electric light plant and will be in market for entire plant excepting power.

Terre Haute, Ind.—Alvin M. Higgins is reported to be chairman of a committee appointed by Mayor Bidaman, to make arrangements for the construction of a municipal electric light plant.

Afton, Ia.—The citizens are reported to have voted to issue bonds for the construction of an electric light plant.

Elkader, Ia.—The Elkader Gas Co. is reported organized, with M. J. Poull, Pres., and L. J. Kramer, Secy., and will shortly petition for a franchise.

Grand Junction, Ia.—Zenor & Week are reported interested in the construction of an electric light plant here.

Afton, Ia.—I. C. Robinson, Town Recorder, writes that the citizens voted Nov. 7 to issue $4,000 bonds for the construction of an electric light plant.

Lincoln Center, Kan.—It is proposed to construct water works and an electric light plant at Lincoln Center, at a cost of $34,500. No engineer selected as yet. Works Committee, at Lincoln, Kan.

Paducah, Ky.—Stone & Webster, 84 State St., Boston, Mass., are interested in the improvements contemplated to the plant of the Paducah Light & Power Co.

Abbeville, La.—Engineer W. Mackintosh, of Abbeville, writes that bids will be received by Geo. W. Summers, Town Secy., until Dec. 18, for constructing water works, an electric light plant and some sewers; probable cost of work $50,000. J. R. Leguenac, Mayor.

Marksville, La.—Bids will be received until Dec. 4 (readvertisement) by C. Ashton Smith, Mayor and the Bd. of Aldermen for constructing water works and an electric light plant. Bids will also be received until Dec. 5 (readvertisement) for the purchase of $15,800 bonds for the above work. Ira W. Sylvester, Con. Engr., Alexandria, La.

Springfield, Mass.—The Stevens Arms Tool Co., of Chicopee Falls, is reported interested in the construction of a water power plant at Sixteen Acres.

Grand Rapids, Mich.—The Michigan Hydraulic Power Co., recently organized here, are preparing to develop some of the water power controlled by it on Manistee River. H. von Schon of Detroit, Consulting Engr.

Flint, Mich.—The City Council is reported to have granted John G. Hesler and Roy W. Evans, of Flint, a franchise for a gas plant.

Appleton, Minn.—Bids will be received by the Village Council until Dec. 5 for furnishing a storage battery to this village, of the capacity of 25 amperes for 8 hours. H. E. Sorlien, Village Recorder.

Bowling Green, Mo.—N. H. Ledford, Pres. and Mgr. of the Pike County Light & Power Co., writes that bids will be received until Dec. 15 for the construction of the proposed plant; probable cost, $7,000.

Tecumseh, Neb.—H. H. Herndon, of Tecumseh, is reported to have petitioned for a franchise for a lighting plant.

Omaha, Neb.—The Gas Co. (Mr. Clabaugh, Secy.) is reported to have decided to construct a gas holder on 22d and Burdette Sts., to cost about $70,000.

Reno, Nev.—W. D. Arnett, a mining engineer, of Reno, is reported interested in the construction of a power and lighting plant, to cost about $100,000.

Jersey City, N. J.—Bids will be received until Nov. 27 by the Bd. Street and Water Comrs. for furnishing of gas and oil street lighting and the lighting and extinguishing of the same in this city for the term beginning Dec. 1, 1905.

Washington, N. J.—Chester Snyder and others, of Easton, are reported to have purchased the plant of the Washington Electric Light Co., and will expend about $10,000 in improvements.

Socorro, N. M.—The Socorro Water, Light & Ice Co. is reported incorporated, with a capital of $30,000, by H. O. Barsum, Elfego Baca and W. E. Marting, of Socorro, and Frank Owen, of Santa Fe, to construct an electric light plant in Socorro.

Las Vegas, N. M.—See "Railroads."

Oswego, N. Y.—The Citizens' Lighting Co. is reported incorporated with a capital of $75,000, to manufacture and sell electricity for light, heat and power. Incorporators: John C. Knight, Thomas Moore and others.

New York, N. Y.—Plans have been filed for a steel gas holder to be erected at 61st St. and Ave. A for the Standard Gas Light Co.; cost, $50,000.

Bids will be received until Dec. 4 by John F. Ahearn, Boro. Pres., for completing the electric lighting system in the Criminal Courts Bldg., Franklin and Centre Sts.

Plattsburg, N. Y.—Bids will be received until Nov. 29 by Capt. T. B. Lamoreux, Q. M., U. S. A., Burlington, Vt., for furnishing and installing electric fixtures in band barracks at Plattsburg Barracks, N. Y.

Lyons, N. Y.—The Niagara, Lockport & Ontario Power Co. is reported to have petitioned the Town Trus. for a franchise in Lyons.

Palmyra, N. Y.—The Niagara & Lockport Power Co. is stated to have petitioned Council for a franchise to erect poles, string wires, build subways, etc., and furnish electricity for heat, light and power.

Buffalo, N. Y.—The following are reported to be the bids opened on Nov. 16 by the Dept. of Pub. Wks., for furnishing and placing cable in conduits between the pumping station and the Ontario St. sub-station: F. P. Little Electrical Constr. Co., as per plans and specifications, $5,550; or, cable suitable for 11,000 volts pressure, $9,713. Robertson Electric Co., cable suitable for 11,000 volts pressure, $5,850; or, as per specifications, $4,350; or, three-conductor B. & S., stranded, insulated with rubber, lead covered, $8,400. Buffalo Electric Contr. Co., 15,000 feet, B. & S., cable, $7,990. Contract Electric Supply Co., 15,000 ft. B. & S., cable, $6,295. Standard Underground Cable Co., 15,000 ft. 11,000 volt cable and installing same, $6,885. General Electric Co., 15,000 ft. 11,000 volt cable, etc., $6,340.

Hope, N. D.—The question of constructing water works and an electric light plant is reported under consideration here.

Cincinnati, O.—The Cincinnati Realty Co. is reported to have decided to erect a power house for use of the Fourth St. Hotel.

East Liverpool, O.—W. A. Calhoun, Pres. Lake Brady Development Co., writes that it is proposed to construct an electric light plant of 3,000 16-c.-p. lights; also water works with towers and pumps, and a complete fire system.

Woodward, Okla. Ter.—The Woodward Cotton Co. proposes constructing an electric light plant, at a cost of $6,000.

Shawnee, Okla. Ter.—Mainland Bros., of Green Bay, Wis., are reported to have purchased the plant of the Shawnee Gas Co., and will improve and enlarge the plant at once. It is stated that plans are ready for the laying of 30 miles of new gas mains.

Salem, Ore.—The Willamette Valley Co. is reported incorporated by A. Welch and C. B. Rhodes, representing a Philadelphia, Pa., banking firm, to control and operate water and lighting plants in different parts of the State.

Pendleton, Ore.—The Northwestern Gas & Electric Light Co. is reported to have secured a franchise for a gas plant.

Philadelphia, Pa.—The following are the totals of bids opened on Nov. 18 by the Bureau of Yards and Docks, Navy Dept., Washington, D. C., for underground lead-cased, braid-covered, arc and incandescent lighting cables at the Navy Yard, League Island, Pa.: Standard Underground Cable Co., 618 Westinghouse Bldg., Pittsburg, $13,165, and John A. Roebling's Sons Co., 612 S. Broad St., Trenton, N. J., $12,911.

Steelton, Pa.—The plant of the Steelton Electric Light Co. is reported to have been destroyed by fire.

Danville, Pa.—Dr. Levi I. Shoemaker, Chmn. Bldg. Com., Bd. Trus. State Hospital for Insane, writes that all bids which were received on and up to Nov. 10 for the erection of a power house, electric generator, plant, engines, boilers, motors, etc., have been returned to the contractors unopened.

Philadelphia, Pa.—Bids will be received by the Dept. of Public Works, Bureau of Lighting, until Dec. 5, for lighting the incandescent naphtha lamps of the city of Philadelphia, as advertised in The Engineering Record.

Trenton, Tenn.—Arthur R. Lowe, of Philadelphia, Pa., is reported to have secured a franchise for a gas plant.

Waco, Tex.—The Federal Gas Co. is stated to have petitioned for a franchise to construct a gas plant.

McKinney, Tex.—W. S. Williams, of the Industrial Gas & Constr. Co., of Chicago, Ill., is stated to have secured a franchise for a gas plant.

Farmington, Utah.—The County Comrs. are reported to have granted J. E. Willey and N. T. Porter an electric light franchise; the estimated cost of plant proposed is $40,000.

Salt Lake City, Utah.—Press reports state that the Denver & Rio Grande R. R. Co. (E. J. Yard, Ch. Engr., Denver, Colo.) has decided to install an electric lighting system for use of its line. Electric plans will be constructed at the Burnham shops, at Pueblo, Grand Junction, Salida and Salt Lake City.

Garfield, Wash.—The Moscow Light & Power Co., of Moscow, Idaho, is reported to have secured a franchise for lighting the city of Garfield.

West Seattle, Wash.—The citizens are reported to have voted to issue $9,000 bonds for the construction of an electric light plant.

Oakesdale, Wash.—The Moscow Electric Light & Power Co., of Moscow, Idaho (E. S. Aldrich, Mgr.) proposes installing an electric light service in Oakesdale, at a cost of $5,000. Bids for construction will be received in April.

Everett, Wash.—Clay Allen, an attorney of Seattle, is reported to have petitioned for a franchise for an electric light plant.

Victoria, B. C.—The British Columbia Electric Co. is reported to be arranging for the laying of 12 miles of gas pipe.

Manitou, Man.—The Manitou Gas Co. is reported formed here to supply the town with gas. Directors: D. D. McTavish, of St. Catherine's, Ont.; R. A. Wyllie, Winnipeg, Man.; John Wooton, Manitou, and others.

ELECTRIC RAILWAYS.

Notes Arranged Alphabetically by States.

Los Angeles, Cal.—The Pacific Electric Ry. Co. is reported to have decided to construct an electric railway between Orange and Santa Ana. It is also reported that the Pacific Electric Ry. Co. will begin at once the construction of a line from Long Beach to Terminal Island, in extension of its Long Beach St. Ry. system. Rights of way for the entire distance between Los Angeles and Covina is reported to have been obtained by the Pacific Electric Ry. Co., and it is announced that construction work will be begun at once. The project includes the future extension of the line to Riverside.

Woodland, Cal.—An ordinance is stated to have been passed granting W. Forsman a right of way along Pendega St. and other streets for a standard-gauge electric road.

San Diego, Cal.—D. C. Collier, Jr., is reported to be seeking a franchise to construct a double-track electric railway along the following route in San Diego: Commencing at University Boule., running east along University Ave. to the east boundary line of San Diego.

Denver, Colo.—The Denver & Southeastern Ry. Co. is reported incorporated to build an electric railway connecting Denver with Colorado Springs and Pueblo. Capital $1,000,000. W. H. Tunis, of Denver; I. C. Cockey, of Washington, D. C., T. A. Sherwood, of Philadelphia, and others are reported interested.

Centralia, Ill.—Chicago promoters are stated to have made a proposition to build an electric railway between Centralia and Salem by way of Odin and Sandoval. The proposed road will cost about $400,000. The Business Men's Association is reported to have the matter under consideration.

Lafayette, Ind.—The Chicago & Southern Traction Co. is reported to have announced that the Lafayette-Kankakee link will be constructed at once.

Indianapolis, Ind.—The coumbus, Greensburg & Richmond Traction Co. is reported to have revived the project to build an electric railway from Columbus to Greensburg and Richmond.

Matthews, Ind.—The Matthews, Marion & Muncie R. R. Co. is stated to have filed incorporation papers with the Secretary of State for the purpose of constructing an electric railway from Marion to Matthews.

Hannibal, Mo.—It is stated that the Hannibal R. R. Co. will extend its line to Oakwood.

Trenton, N. J.—The Common Council is stated to have passed the ordinances giving power to the Trenton St. Ry. Co. and to the Trenton, Hamilton & Ewing Traction Co. to build the loop in Perry St., and the extension of the W. State St. tracks from Parkside Ave. to Trenton Junction.

Roswell, N. M.—It is stated that J. W. Hall, of Memphis, Tenn., representing Eastern capitalists, is in Roswell with a view of securing a franchise for the establishment of an electric railway in this city.

Fremont, O.—The power station and car house of the Creager Electric Ry. & Power Co. is reported to have been destroyed by fire.

Cincinnati, O.—The Interurban Railway & Terminal Co. is stated to have decided to abondon its generating station at South Lebanon and move the two 800-hp. units to the station at Coney Island, increasing the capacity of that plant to 6,000 hp. To accomplish this, the company will build a transmission line 8 miles in length.

Canton, O.—The Akron-Canton-Youngstown Ry. Co. is reported to have announced that the work of constructing the line will begin in the early spring, and the greater portion of the right of way has been secured. The road will be 63 miles in length, and connect Akron, Canton and Youngstown.

**Items marked thus give the names of parties awarded contracts.*

Norwalk, O.—It is reported that the Sandusky, Norwalk & Mansfield Ry. and the Baltimore & Ohio R. R. will build jointly an overhead crossing at Chicago Junction.

Oklahoma City, Okla. Ter.—The City Council is reported to have granted a franchise to the Oklahoma Interurban Traction Co. to construct an electric railway in the southern portion of Oklahoma City. It is the intention to build a line from Oklahoma City to Capitol Hill and to Norman.

New Castle, Pa.—The Shenango Traction Co., which proposes to build an electric railway from New Castle to Meadville via Sharon, Sharpsville and Greenville, is stated to have decided to make applications for charters for the following lines: New Castle Northern, New Castle Central, Northern Middlesex, and Shenango Southern; Shenango, Midland; Shenango Northern. Incorporators: J. D. White, of Pittsburg; W. H. Waugh, of Greenville, and others.

Shamokin, Pa.—The Borough Council has granted the Shamokin & Edgewood Electric Ry. Co. the right to change the gauge of track from 5 ft. 2 in. to the regulation railroad gauge, which will be changed to Edgewood Park. From this point a corps of engineers is surveying a line to Trevorton, about 8 miles distant.

Knoxville, Tenn.—It is stated that the Knoxville & Maryville Ry. Co. has decided to incorporate with a capital of $100,000, to build an electric railway from Knoxville to Maryville. Jos. Burger, of Maryville, and J. P. Gaut, Robert Vestal, and others of Knoxville, Tenn., are the incorporators.

Spokane, Wash.—Directors of the Spokane & Inland Ry Co. are reported to have authorized the extension of the system from Waverly, Wash., to Rosalia, a distaance of 14 miles. F. A. Blackwell, Gen. Mgr., has been authorized to receive tenders.

Montreal, Que.—An expenditure of $1,000,000 during the coming year in constructing new feeder lines and installing additional machinery in the main power house and the various sub-stations, etc., is reported to have been decided upon by the Bd. of Directors of the Montreal St. Ry. Of this sum, about $500,000 will be set aside for the construction of new cars, for the erection of feeder lines and the erection of new car houses. The remaining half million will be applied for the installation of additional machinery in the power plant.

RAILROADS.

Notes Arranged Alphabetically by States.

Birmingham, Ala.—The Illinois Central R. R. Co. (A. S. Baldwin, Ch. Engr., Chicago, Ill.) is about to petition City Council for a franchise to enter the city by way of Corinth, Miss, over the tracks of the Mobile & Ohio R. R. From Corinth to Haleyville, Ala., the company will build its own track, a distance of 80 miles.

New Haven, Conn.—At a special meeting of the stockholders of New York Air Line R. R. Co., at the office of the N. Y., N. H. & Hartford R. R., at New Haven, Conn., on Nov. 13, it was voted to authorize the issue of $5,000,000 of bonds, and the extensions of a mortgage on the company's property to secure them. It is reported that the money from the sale of the bonds is to be used in double-tracking the Air line division between New Haven and Willimantic.

Hartford, Conn.—The Common Council has passed a resolution authorizing the joint standing committee on railroads, and the City Engineer, to report a plan and the expense of abolishing the Walnut St. grade crossing.

Sterling, Ill.—The Chicago, Burlington & Quincy R. R. Co. (H. D. Johnson, Gen. Supt., Chicago) is reported to have decided to build a line from Sterling to Savanna.

Charleston, Ill.—The Charleston R. R. Co. is reported incorporated to construct a railroad from Charleston easterly through Coles and Clark Counties to a point in Clark county on the line from Charleston to Terre Haute, Ind.

Anderson, Ind.—The Cleveland, Cincinnati, Chicago & St. Louis R. R. Co. (G. W. Kittredge, Ch. Engr., Cincinnati, O.) is reported to be considering the double-tracking of its line between Anderson, Indianapolis and Muncie.

Dawson Springs, Ky.—W. G. Harris, of Dawson Springs, Pres. Dawson Springs & Madisonville R. R. Co., writes that the American Eng. Co., of Indianapolis, Ind., has made a survey for the proposed railroad, which will be about 20 miles in length.

Morehead, Ky.—Wm. M. McCormick, Philadelphia, Pa.; John W. Wrigley, Clearfield, Pa., and Lewis Starr, Woodbury, N. J., are reported to be incorporators of the Morehead and North Fork R. R. Co., recently incorporated with a capital of $500,000, to build a railroad in Kentucky.

**Harrison, N. J.*—Contracts for the construction of what is to be known as the Tunnel Route of the Pennsylvania R. R. from Harrison to a point some 3,000 feet north of Tyler Park and 2,000 feet south of Homestead, are reported to have been awarded as follows: The principal contract, for the construction of the roadbed and bridges, has been awarded to McMullen & McDermott, Newark. The Drake & Stratton Co., of Philadelphia, Pa., will build the Hackensack bridge, a structure 1,100 ft. long, with two draws, and H. S. Kerbaugh, Inc., of Philadelphia, and the B. M. and J. F. Shanley Co., of this city, will raise the grade of the present line from the American Crucible Co.'s plant, Harrison, to a point 1,000 ft. west of the Waverly cut-off, where the "tunnel route" will cross the Lackawanna road: total cost of proposed work will be about $3,000,000.

Las Vegas, N. M.—The preliminary survey of the Las Vegas cut-off of the El Paso & Southwestern R. R. (H. J. Simmons, Gen. Mgr., El Paso, Tex.) is stated to have been completed. It provides for a short line from the Dawson coal fields to a point on the eastern division of the El Paso & Southwestern, near Torrance, the line touching the town of Las Vegas.

W. H. Colburn is reported interested in the construction of a narrow-gauge railroad from Las Vegas to the Mineral Hill District. He is also reported to have petitioned for a franchise for a gas plant.

Andrews, N. C.—The Snowbird Valley Ry. Co., of Andrews, has been incorporated, with a capital of $75,000, to construct the line of the Southern R. R. in Cherokee County and into Graham County. The road will be 15 miles in length. Incorporators: W. A. Lewin, W. B. Hamrick, C. M. Hickerson and others, of Andrews, and W. A. Lewin, of Staunton, Va.

Cincinnati, O.—The Chesapeake & Ohio R. R. Co. (H. Pierce, Richmond, Va., Engr. of Construction) is reported to have decided to improve the Cincinnati division of its line within the next year. It is proposed to lay 100 lb. rails from Cincinnati to Russell, Ky., a distance of 156 miles, except where double tracks are in use.

Martin's Ferry, O.—The Pennsylvania R. R. Co. (W. H. Brown, Ch. Engr., Phila., Pa.) is reported to have decided to double-track the C. & P. division from the Terminal Junction above Martin's Ferry to Bellaire, a distance of about 7 miles.

Brookville, Pa.—Bids will be received until Dec. 10 by W. W. Henshey, Ch. Engr., Brookville & Mahoning R. R. Co., for the construction of about 21 miles of railroad involving about 500,000 cu. yds. of excav., 200,000 cu. yds. borrow embankment, 20,000 cu. yds. bridge and culvert pipe, 12, 18 and 24-in. diameter, 1,900 tons steel bridges and viaducts.

Sharpsburg, Pa.—The Council is reported to have passed an ordinance granting certain concessions to the Pennsylvania R. R. Co. (W. H. Brown, Ch. Engr., Philadelpia); $3,000,000 will be expended in improvements, to include the elimination of grade crossings, building shops, etc.

Due West, S. C.—It is stated that bids will be received until Dec. 1 by R. S. Galloway, Due West, for grading 4½ miles of railway for the Due West Co., from Donalds to Due West.

Spearfish, S. D.—The Burlington & Missouri River R. R. Co. (H. E. Bryan, Gen. Supt., Lincoln, Neb.) is reported to be preparing to begin work next spring on an extension from Spearfish north into Butte county.

Big Springs, Tex.—A charter of the West Texas & Northern Ry. Co. has been filed with the Secy. for the construction of a railroad from Kerrville northwest via Junction City, San Angelo, Big Springs, Lubbock and Plainview, Tex., to Amarillo, a distance of about 450 miles. Main office at Big Springs. Capital, $500,000. E. P. Spears, Pres., Dallas.

Salt Lake City, Utah.—Archibald C. Milner, of Salt Lake City, Vice-Pres. Coast Belt Ry. Co., writes that construction work on its proposed line through Utah, Wasatch and Carbon Counties to the coal mines about 89 miles in length, will not start until sometime next year.

**Spokane, Wash.*—The Spokane-Columbia River Railroad & Navigation Co. is reported to have awarded to M. P. Zindorf of Seattle, the contract for grading 63 miles of railroad from the Columbia River to Fletcher.

Seattle, Wash.—The Chicago, Milwaukee & St. Paul R. R. Co. (D. J. Whittemore, Ch. Engr., Chicago, Ill.) is stated to have petitioned the City Council for the right to enter the city and establish terminals at that point It is said to be the intention of the St. Paul to touch Helena, Spokane, Tacoma and Portland.

Santiago, Chile.—Bids will be opened Jan. 2 at Santiago, for constructing a railway of one-meter track from the Arica Port (Chile) to La Paz (Bolivia).

PUBLIC BUILDINGS.

Notes Arranged Alphabetically by States.

Ashland, Ala.—Chamberlain & Co., of Birmingham, it is reported, have been engaged to prepare plans for a court house which is to be reported here at a cost of $40,000. It is reported that bids for the construction will soon be asked.

**Globe, Ariz.*—Peter Wilson, it is stated, has secured the contract to erect the court house at about $35,000.

Prescott, Ariz.—Bids will be received until Dec. 22 by Capt. Chas. C. Walcutt, Jr., Constr. Q. M., Prescott, for construction, plumbing, hot-water heating and electric wiring of hospital at Whipple Barracks, Ariz., as advertised in The Engineering Record.

San Francisco, Cal.—It is stated that plans are to be received in competition for the public library.

Harwinton, Conn.—The late Theo. Hungerford, of New York, N. Y., it is stated, has bequeathed $25,000 to erect a library in this village.

Chicago, Ill.—Bids will be received until Dec. 4 by the Bd. Co. Comrs. for the caisson foundations required for the Cook Co. Court House, to be erected on the east half (½) of block 39. Plans and specifications may be had upon a deposit of $25. Holabird & Roche, Archts., 218 La Salle St.; Wm. McLaren Co. Supt. Pub. Service.

The Chicago Home for Jewish Orphans, Drexel Ave. and 62d St., conducted by the Associated Jewish Charities, it is stated, has received a gift of $20,000 for the construction of an assembly hall and administration building. It will be 2 story, of pressed brick and stone. No architect has been engaged yet. It is the intention to begin work on the building as soon as possible.

Indianapolis, Ind.—Bids will probably be called for in Feb. or Mar. for completing the Methodist Hospital, at a cost of $65,000, the contract to include fire proofing, heating, electric work, elevator, plastering, glazing, etc. Substructure of building now under construction. Cost of building complete will be $115,000. Architects, Vonnegut & Bohn, Indianapolis.

Ft. Des Moines, Ia.—It is reported that plans have been completed for a brick and steel, 240 x 108-ft. riding hall, to be erected at Ft. Des Moines, at an estimated cost of $140,000.

Des Moines, Ia.—The erection of a State tuberculosis sanitarium to cost about $150,000 is reported under consideration.

**Council Bluffs, Ia.*—The Bd. of Mgrs. of the Woman's Christian Assoc., it is reported, has awarded the contract to erect the Jennie Edmundson Memorial Hospital to the Consolidated Constr. Co., of Council Bluffs, at about $40,000. The contract for the heating and plumbing will be let separately and will cost about $5,000.

Burlington, Ia.—The following are the bids opened on Nov. 15 by the Superv. Archt., Treas. Dept., Washington, D. C., for plumbing in the U. S. Court House and Post Office: Bartlett & Kling, Cedar Rapids, $3,600, and C. G. Bond, Burlington, $5,491.

Ft. Leavenworth,. Kan.—Bids will be received by Capt. J. E. Normoyle, Q. M., U. S. A., until Dec. 18, for the construction of Grant Hall and remodeling Sherman and Sheridan Halls, as advertised in The Engineering Record.

Shreveport, La.—It is reported that fire on Nov. 20 destroyed the city hall, city market and several other buildings.

Milford, Mass.—At the town meeting held Nov. 15, it is stated, it was voted to borrow $20,000 to erect an armory for Co. M, 6th Infantry.

Holyoke, Mass.—It is stated that plans have been prepared for an armory to be erected here for Co. D.

**Ft. Wayne (Detroit), Mich.*—Wm. Hamilton, of Des Moines, Ia., it is stated, has secured the contract to erect 2 barracks and a lieutenants' and a captains' quarters at this post (bids for which were opened Oct. 4) at $122,237 for all. Jas. Partlan, 56 Congress St., E., secured the contract for plumbing said buildings at $7,961, and Norris & Miller, 252 Randolph St., the contract for gas piping at $5,438.

Minneapolis, Minn.—Plans have been prepared, it is reported, by Bertrand & Chamberlain, Bank of Commerce Bldg., for a police station to be erected at 1st Ave., S. E., and 4th St., at a cost of about $15,000.

New Albany, Miss.—The Bruce Architectural Co., of Birmingham, Ala., it is stated, has been engaged to prepare plans for a court house, which it is proposed erecting here.

Hornellsville, N. Y.—The Bd. of Superv., it is stated, have been petitioned to erect a court house at Hornellsville, at a cost of about $30,000.

New York, N. Y.—Bids will be received until Nov. 28 by the Armory Bd. (Mayor Geo. B. McClellan, Chmn.) for furnishing material, making repairs and alterations to the several armories of the organizations of the N. G., N. Y., in the Boros. of Manhattan and Brooklyn, as follows: Extension to the 13th Regt. Armory, Boro. Brooklyn., Parfitt Bros., Archts., 24 Court St., Boro. Brooklyn; lighting fixtures for the new 71st Regt. Armory; also lockers for said armory, Boro. Manhattan, Clinton & Russell, Archts., 32 Nassau St., Boro. Manhattan; new floor in drill hall, 14th Regt. Armory, Boro. Brooklyn, Robinson & Kunst, Archts., 164 5th Ave., Boro. Manhattan.

Bids will be received until Dec. 1 by the Bd. Trus., Bellevue and Allied Hospitals (John W. Brannan, Pres.) for furnishing material and erecting iron balconies, including repair work, on the ward wings of the new Harlem Hospital, Lenox Ave. and 136th St.

Bids will be received until Dec. 5 (readvertisement) by Maurice Featherson, Comr. Docks and Ferries, for furnishing material and erecting at the foot of Whitehall St., East River, a new ferry house in connection with the new Whitehall Ferry Terminal.

**Winston, N. C.*—The General Supply & Constr. Co., of New York, N. Y., has secured the contract for the construction of the U. S. Court House and Post Office for $47,000.

Laurinsburg, N. C.—It is reported that bids are wanted until Dec. 1, for erecting a 3-story hospital. Dr. D. M. Prince, Mgr., Laurinsburg Hospital.

Lillington, N. C.—Bids will be received until Jan. 1 by the Bd. Co. Comrs., for constructing a jail and certain fireproof record vault work in the county court house, Bids may be submitted separately or as a whole on the above works. For further information address C. M. Muse, Co. Attorney.

Hillsboro, N. D.—Press reports state that bids will be received until Jan. 8 by the Bd. Co. Comrs. for erecting a court house. Buechner & Orth, Archts., St. Paul, Minn.

Bismarck, N. D.—The Supreme Court, it is stated, has declared invalid the law creating a State Capitol commission, authorizing the erection of the new capitol and executive mansion, and the issue of $600,000 of certificates based on the capitol land endowment for that purpose. The Capitol Commission bill was passed at the last session of the legislature and authorized the appointment of a commission to rebuild and reconstruct the present State capitol and construct an executive mansion. The land grant granted by congress for the purpose of erecting administration buildings was authorized to be used, and in the meantime the commission was authorized to issue $600,000 of certificates to furnish funds until the lands could be sold. Bids for the erection of this building were to have been received Dec. 12.

Bellefontaine, O.—Robt. C. Gotwald, of Springfield, it is stated, has been engaged by the Bd. Pub. Service, to prepare plans for the west end fire station.

Cleveland, O.—Bids will be received until Dec. 6 by the Bd. Pub. Service (A. R. Callow, Secy.) for furnishing material and erecting complete a shelter house in Wade Park. Probable cost, $12,000.

**Guthrie, Okla. Ter.*—Boswell, Horn & Co., of Wichita, Kan., has secured the contract for the low-pressure steam heating apparatus of the U. S. Post Office and Court House (bids opened Nov. 7) for $4,048.

Philadelphia, Pa.—It is stated that a site has been secured in the 21st Ward, on which it is proposed erecting a branch library and for which plans are to be prepared by Benj. R. Stevens, Bullitt Bldg., the cost to be about $25,000.

Ft. Meade, S. D.—Bids will be received until Dec. 15 by Geo. K. Hunter, Constr. Q. M., Ft. Meade, for constructing and plumbing a brick stable at this post.

Bristol, Tenn.—It is stated that Bishop Donahue, of Wheeling, W. Va., is interested in the erection of a hospital here to cost about $75,000.

Channing, Tex.—It is stated that bids will be received until Dec. 2 by the Comrs. Court for furnishing material and constructing a brick and stone court house. O. G. Roquemore, Archt., Amarillo, Tex.; J. C. Thompson, Co. Clk.

Paris, Tex.—It is stated that bids will be received until Dec. 5 by the Co. Comrs. for erecting a brick hospital on the county farm near Paris. Barry & Smith, Archts., Paris; John W. Love, Co. Judge.

Walla Walla, Wash.—Plans and specifications will be received until Dec. 4 by the Bd. Co. Comrs. (W. J. Honeycutt, Clk.) for a 2-story jail cost, including plumbing and steam heating, not to exceed $30,000.

**Items marked thus give the names of parties awarded contracts.*

Milwaukee, Wis.—The erection of a 2-story addition to the Milwaukee Hospital for the Chronic Insane, to be known as the industrial building, is reported to be under consideration.

Evanston, Wyo.—The following are the bids opened on Nov. 22 by the Superv. Archt., Treas. Dept., Washington, D. C., for the low pressure steam heating apparatus complete for the U. S. Post Office and Court House at Evanston: Midgley Bros., Salt Lake City, Utah, $5,500; Iowa Mfg. Co., Oskaloosa, Ia., $5,456; and G. A. Kres-Dometer Co., St. Paul, Minn., $4,899.

Montreal, Que.—Bids will be received until Dec. 1 by the Dept. Pub. Works. (Fred Gelinas, Secy.), Ottawo, Ont., for erecting a central pneumatic postal station at Montreal. Maurice Perault, Archt., Montreal.

Panama.—Bids will be received by Alfred Anderson, Asst. Purchasing Agent, Panama R. R. Co., 24 State St., New York, N. Y., until Dec. 5, for the construction of laundry and bakery buildings, as advertised in The Engineering Record.

BUSINESS BUILDINGS.

Notes Arranged Alphabetically by States.

Mobile, Ala.—Davis Temple Lodge No. 1,672, I. O. O. F., it is stated, has accepted the plans of Geo. D. Hulbert & Co., of Mobile, for a 3-story brick, 55 x 125-ft. theatre and lodge building, which they intend erecting at Davis Ave. and Wilkinson St., at a cost of $40,000.

Little Rock, Ark.—Theo. C. Link, of St. Louis, Mo., it is stated, has been engaged to prepare plans for the depot which the St. Louis, Iron Mountain & Southern Ry. (E. Fisher, Engr. of Bridges & Bldgs., Pacific, Mo.) intends erecting here.

**Grand Junction, Colo.*—Verner Z. Reed, of Colorado Springs, it is stated, has awarded the contract to erect the Reed Block in this city to W. C. Boyer, the cost to be about $30,000.

Colorado Springs, Colo.—Mrs. Mary S. N. Robinson, it is reported, has had plans prepared for a $20,000 business building, to be erected at 26 E. Pike St.

Pueblo, Colo.—It is reported that G. Henry Whitcomb contemplates erecting a $100,000 business building.

Denver, Colo.—The Brown Investment Co., it is stated, intends erecting a $100,000 hotel at Grant and 14th Sts. Harry K. Brown is a member of the company.

Norwich, Conn.—The Southern New England Telephone Co., it is stated, is having plans prepared by L. W. Robinson, of New Haven, for a 2-story and basement building which they propose erecting in Norwich.

Pensacola, Fla.—F. C. Brent proposes erecting a steel fireproof building 3 stories high on site of the one recently burned.

Atlanta, Ga.—The Southern Bell Telephone & Telegraph Co., it is stated, has secured a permit to erect a 4-story building at Auburn Ave. and N. Pryor St., to cost $75,000.

Atlanta, Ga.—A 2-story brick building is to be erected at Gordon St. and the West End by the Western Electric Co., of Chicago, Ill., at a cost of $50,000.

Twin Falls, Idaho.—The Twin Falls Investment Co., it is stated, intends erecting a hotel to cost $25,000.

**Boise, Idaho.*—I. N. Hall, 1331 Grove St., it is reported, has secured the contract for the superstructure of the Idaho Independent Telephone Co.'s building at Jefferson and 10th Sts., the cost to be $15,015.

Ada Lodge, No. 3, I. O. O. F., it is reported, intends erecting a lodge building at 9th and Idaho Sts., the cost to be about $100,000.

Springfield, Ill.—The Peter Vardenburgh Lumber Co., it is reported, is planning to erect a $25,000 brick warehouse.

Waukegan, Ill.—It is reported that arrangements are being made for the erection of a depot here by the Chicago & North Western Ry. (E. C. Carter, Ch. Engr., Chicago), estimated to cost $50,000.

Galesburg, Ill.—The Order of the Elks, it is reported, is contemplating the erection of a $40,000 building.

Rockford, Ill.—It is reported that $150,000 bonds have been sold by the Graham Bldg. Co. for a building to be erected at State and Main Sts.

Evansville, Ind.—The Bijou Circuit Assoc., it is stated, intends erecting a $75,000 theatre here.

Lafayette, Ind.—C. B. Jamison, Supt. Bldg. Com., Y. M. C. A., writes that J. F. Alexander & Son, Perrin Bank Bldg, are preparing plans for a building, to cost about $50,000.

Webster City, Ia.—The Webster City Armory and Opera House Co., it is stated, has been incorporated with a capital of $15,000, for the purpose of erecting a brick opera house and armory, 43 x 120 ft.

Davenport, Ia.—The Schick Express Co., it is reported, is contemplating the erection of a 7-story warehouse.

Sioux City, Ia.—T. R. Galbraith, Mgr. of the Massachusetts Real Estate Co., it is reported, has announced that plans for the Massachusetts building, to be erected by this company, will be completed by Henry Fisher, Toy Bldg., within a short time, and that bids for the construction will then be received. Probable cost, $120,000.

Topeka, Kan.—Holland & Squires, 734 Kansas Ave., it is reported, are preparing plans for a $75,000 club house for the Elks Lodge. C. K. Holliday, Secy.

Louisville, Ky.—Wm. Albert Swasey, of New York, N. Y., it is stated, is preparing plans for a theatre which it is proposed erecting on 4th Ave. and Chestnut St., for the use of the Shubert syndicate, the cost to be about $75,000.

Lexington, Ky.—The erection of an opera house here by the Belasco-Shubert-Fiske combine is reported under consideration.

New Orleans, La.—Henry Davis, it is stated, has secured a site at Univ. Pl. and Canal St., and has announced that he will erect a 6-story store and office building.

Baltimore, Md.—The directors of the Metropolitan Savings Bank have commissioned Parker & Thomas, 612 N. Calvert St., to prepare plans for a new building which they propose erecing at Charles and Saratoga Sts.

Havre de Grace, Md.—It is stated that the Pennsylvania R. R. Co. (W. H. Brown, Ch. Engr., Philadelphia, Pa.) intends erecting a $30,000 passenger station here.

**Worcester, Mass.*—E. J. Cross, 82 Foster St., it is stated, has secured the contract to erect the superstructure of the 4-story, 44 x 138-ft. Odd Fellows Bldg. on Main St.

South Haven, Mich.—Henry L. Vanderhorst, of Kalamazoo, it is stated, has secured the contract to erect a brick passenger station at South Haven for the Michigan Central R. R., at a cost of about $25,000.

Ishpeming, Mich.—Charlton, Gilbert & Demar, of Marquette, have prepared plans for rebuilding the Miners' National Bank Bldg.; probable cost, $20,000. Address A. B. Miner, Ishpeming.

Minneapolis, Minn.—The Crane Co., of Chicago, Ill., it is reported, has purchased a site on 4th St. and 3rd Ave. N., and intends erecting next spring a 5-story concrete warehouse, 60 x 162 ft., for the Plumbers & Steam Fitters' Supply Co., the cost to be about $200,000.

M. H. Cohn, representative of the International Theatrical Co., it is stated, has announced that his company proposes erecting a theatre at 6th St. and Hennepin Ave., the site and building to cost about $150,000.

The McQuaid Co., it is reported, will erect a $60,000 building on Hennepin Ave., near 7th St.

St. Louis, Mo.—It is stated that articles of incorporation have been filed by the November Investment Co., which proposes erecting a building to cost about $1,000,000. Among the stockholders are: Robt. Rutledge, Saml. T. Yourtee and Frank M. Allen.

Kansas City, Mo.—The Kansas City Motor Car Co., it is reported, has purchased a site at 310 W. 9th St. and intends erecting a 3-story brick garage.

**Newark, N. J.*—The Trivett & Walters Co., 103 Brill St., it is reported, has secured the general contract for the 6-story store and loft building to be erected for Philip J. Bowers and Wm. S. Fairchild, at 54 Clinton St. Hooper & Co., 238 Washington St., are the archts.

Utica, N. Y.—G. Edw. Cooper, 236 Genessee St., it is stated, has been selected to prepare plans for an addition which is to be erected next spring to the Masonic Home.

Rochester, N. Y.—Rev. J. F. Staub, pastor of the Holy Redeemer Church, it is stated, has obtained a permit to erect a $40,000 parish house on Clifford St.

New York, N. Y.—Plans have been filed, it is stated, by D. O. Mills for a 15-story hotel, to be erected at 36th St. and 7th Ave., to be known as Mills Hotel No. 3. The structure is to be of steel, iron, stone and terra cotta, and is to cost about $1,000,000.

Brooklyn, N. Y.—Plans have been filed for two 5-story and basement stores and tenements, to be erected at Montieth and Bremen Sts., at a cost of $22,000 each. A. Goodman and S. Shapiro, 732 Bway., owners; R. T. Rasmussen, 30 Graham Ave., Archt.

High Point, N. C.—The erection of a $50,000 building for the Manufacturers' Club, is reported to be under consideration.

Cleveland, O.—The Reserve Trust Co., it is stated, intends erecting a 5-story store and apartment house at Willson and Woodland Aves, to cost $75,000.

Toledo, O.—Marshal Sheppy, Sinclair Bardan, and others are said to be interested in a company which proposes erecting a garage on Monroe St., to cost $50,000, and for which it is stated plans are being prepared by G. S. Mills, Gardner Bldg.

Cincinnati, O.—Edwin Schlochtermeyer, Linn and Hopkins Sts., it is stated, has prepared plans for an apartment house to cost about $80,000 and for a hotel to cost about $350,000, both of which, it is stated, are to be erected on Price Hill by a company which is to be formed and will probably be known as the Grandview Realty Co.

Henry Burkhold, it is stated, has announced that he intends erecting an 8-story building at 4th and Main Sts., and has had plans prepared by Berling & McDowell, of Chicago, Ill. The building is to be of steel, iron and brick and is estimated to cost $150,000.

Philadelphia, Pa.—D. H. Burnham & Co., Ry. Exchange, Chicago, Ill., it is reported, are receiving bids for the erection of a 2-story store and office building, to be erected on the Girard House site at 9th and Chestnut Sts., the cost to be about $150,000.

*The following are reported to be the bids received by G. W. & W. D. Hewitt, Archts., Bullitt Bldg., for the erection of a 5-story concrete addition, 18 x 90 ft., to the warehouse of Felton, Sibley & Co., at 409 Cherry St.: Cramp & Co., 1421 Filbert St., $25,651 (awarded contract); Chas. Gilpin, $26,550; J. E. & A. L. Pennock, $26,680; Thos. Little & Son, $26,900; Roydhouse, Arey & Co., $30,899; Metzger & Wells, $32,033; and Armstrong & Latta, $33,350.

*S. E. Moore, it is stated, has been awarded the contract to erect the office building for the Girard Trust Co., at Broad and Chestnut Sts. The cost to be about $900,000. It will be a marble structure, 115 ft. high, surmounted by a tiled dome. The dimensions will be 137x 114 ft. McKim, Mead & White, archts, N. Y. City.

Pittsburg, Pa.—A building permit has been granted to J. W. Barker, to erect a 3-story brick store and lodge building on 2d Ave., to cost $25,000.

**Woonsocket, R. I.*—The Builders' Concrete Stone Co., of Pawtucket, it is reported, has been awarded the contract for building the Providence & Burrville St. Ry. Co.'s car house on Park Ave. The plan calls for a structure 55x110 ft., with 2 additions, one 60x130 ft. for offices, boilers and machine shop, and one 20x13 ft. for salt and sand bins.

Conway, S. C.—It is stated that bids will be received until Dec. 15 by H. E. Bonitz, Archt., Wilmington, N. C., for erecting a 2-story bank, 60x100 ft., for the Bank of Conway.

Sioux Falls, S. D.—It is reported that bids are wanted until Dec. 1 for a steam heating plant in the Masonic Temple at this place. Geo. A. Pettigrew, Treas.

Chattanooga, Tenn.—The Bd. of Directors of the Bijou Theatre Co., it is stated, has selected certain archts. to submit plans to the Bldg. Com. (J. H. Daly, Chmn.) by Dec. 1 for the theatre which is to be erected at a a cost of about $40,000.

Bristol, Tenn.—R. F. Graf, of Knoxville, Tenn., it is reported, has completed plans for a Y. M. C. A. Bldg., which is to be erected at Bristol, at an estimated cost of $100,000.

Nashville, Tenn.—The Directors of the Young Men's Hebrew Assoc., it is stated, have secured a site on Union St., and contemplate erecting early next spring a club, to cost about $25,000.

Wichita Falls, Tex.—J. A. Kemp, it is stated, is interested in the project to erect an opera house here to cost about $25,000.

Temple, Tex.—It is reported that the Knob Creek Lodge, No. 40, of the Masons, will erect a $15,000 lodge building.

**Richmond, Va.*—It is reported that the Southern Constr. Co., of Norfolk, has secured the contract for fireproofing the Jefferson Hotel, at about $40,000.

Norfolk, Va.—The Fairfax Realty Co., it is stated, has been granted a charter and has appointed the following officers: Geo. W. Day, Pres.; W. T. Ham, Vice-Pres., and F. W. Porter, Secy. Breese & Mitchell, it is stated, have been engaged by the company to prepare plans for a 7-story brick fireproof hotel which is to be erected at City Hall Ave. and Randolph St., and is to cost about $125,000.

Seattle, Wash.—The erection of a natatorium on 4th Ave. and University St., to cost about $30,000, is reported under consideration. Geo. Virtue, Thos. O'Brien and others of Seattle are interested.

The Seattle Electric Co. (M. Lowd, Ch. Engr., 5th and Pine Sts.) it is reported, will erect car barns to cost complete about $200,000.

*It is reported that a permit has been granted to Mrs. E. C. Bancroft, 901 Pike St., to erect a 3-story brick and concrete store and lodging house, to cost $25,000. W. P. White, Archts, Washington Bldg.; C. L. Williams, builder.

Spokane, Wash.—J. M. Geraghty, it is stated, is having plans prepared for a 2story brick warehouse, to be erected on Pacific Ave., at a cost of $20,000.

Harold Hals, Exchange Bank Bldg., it is stated, has completed plans for the 3-story brick $16,000 warehouse which is to be erected at Desmet and Division Sts. for E. E. Bergum.

It is stated that a building permit has been granted to the Holl-Mason Hardware Co. to erect a $100,000 6-story brick block at Railroad Ave. and Howard St.

Tacoma, Wash.—Saml. Rosenberg and Leopold M. Stern, of Seattle, it is stated, have purchased a site at South C and 13th Sts., and will erect a 6-story business block.

S. A. Perkins, it is stated, intends erecting a 5-story 50 x 100-ft. building at A and S. 11th Sts. for the Ledger and Daily News.

Eugene Levey, of Seattle, it is stated, intends erecting on C and Commerce Sts., a 4-story reinforced concrete business block to cost $35,000.

Bellingham, Wash.—Mitchell Bros., it is stated, are planning to erect a 3-story red pressed brick building on Magnolia and Dock Sts., the cost to be about $20,000.

Bluefield, W. Va.—The Masonic Temple Assoc. (F. J. Brown, Secy.) it is reported, proposes erecting a $25,000 building.

Oshkosh, Wis.—The Chicago, Milwaukee & St. Paul Ry. (D. J. Whittemore, Ch. Engr., Chicago, Ill.) is preparing to erect a $40,000 depot here.

**Madison, Wis.*—The contract to erect a freight house for the Chicago & North Western Ry., it is reported, has been awarded to T. C. McCarthy, of Madison, at about $29,920.

Montreal, Que.—Hardenbergh & Gilbert, of New York, N. Y., and Hutchinson & Wood, of Montreal, it is stated, are the Assoc. Archts. whose plans have been accepted by the Bd. of Directors of the Windsor Hotel, for the new hotel which is to be erected on the site of the present Windsor Hotel and is to contain about 800 rooms.

Vancouver, B. C.—It is stated that a building permit has been issued for the Kelley Douglas warehouse, to be erected on Water St., which is to cost about $70,000.

CHURCHES AND DWELLINGS.

Notes Arranged Alphabetically by States.

**New Haven, Conn.*—The Central Bldg. Co., Worcester, Mass., it is stated, has secured the contract to erect a residence at Prospect and Harriet Sts., New Haven, for L. E. Stoddard, the cost of the building complete, to be about $125,000.

Atlanta, Ga.—The Greek Catholics, it is reported, are preparing to erect a $15,000 edifice here. Rev. C. Demetriou, Pastor.

Chicago, Ill.—It is stated that plans have been completed by Holabird & Roche, 1618 Monadnock Bldg., and contracts will be let in a short time for the 14-story addition to the Auditorium Annex, an apartment house in Michigan Ave., the cost to be not less than $800,000.

**Indianapolis, Ind.*—The general contract for erecting the Meridan St. M. E. Church at Meridan and St. Clair Sts., it is stated, has been secured by John A. Schumacher Co., 820 E. St. Clair St., at $83,400. The contract for the steam heating and plumbing, it is stated, has been awarded to Geo. Keyser, 946 Ft. Wayne Ave., at $6,673.

Medford, Mass.—Bids will soon be called for to erect a stone church for the Methodist Episcopal Society. Estimated cost, $20,000. Louis Dow Melrose, Archt. Rev. E. C. Bridgham, 127 Park St., Chn. of Com.

Kansas City, Mo.—It is stated that the congregation of B'nai B'rith intend erecting a new temple at Linwood Boule. and Harrison St., the cost to be about $100,000.

St. Louis, Mo.—It is reported that the congregation of the Shaw Ave. M. E. Church proposes erecting a $25,000 edifice.

The congregation of the South Grand Ave. Methodist Church, it is reported, contemplates erecting a $50,000 edifice.

Helena, Mont.—Bishop John P. Carroll, it is stated, has secured a site and contemplates erecting a cathedral here.

Omaha, Neb.—It is reported that plans have been completed for a $50,000 edifice for All Saints Episcopal Church. Address Rev. T. J. Mackay, Rector.

**Items marked thus give the names of parties awarded contracts.*

Newark, N. J.—It is stated that Peter Charles, 742 Broad St., has completed plans for a 4-story brick apartment which Hyman Rachlin will erect at 40 Rutgers St., at a cost of $25,000.

Haddonfield, N. J.—Henry D. Moore, it is stated, has made an offer to the First Presbyterian Church, which has been accepted to erect a new edifice to cost $60,000, on condition that the congregation erect a new manse, to cost $12,000.

New York, N. Y.—Plans have been filed for a new fireproof synagogue and school to be erected at 132-142 East 111th St., for the Congregation Talmud Torah. It is to be a 4-story and basement edifice, with a facade of brick trimmed with granite and limestone. The school annex will contain a 2-story gymnasium and an assembly hall. The building to cost $250,000.

Brooklyn, N. Y.—Plans have been filed for a 6-story brick tenement, to be erected at S. 3d and Havemeyer Sts., the cost to be $50,000. Goell & Weller, 540 Sutter Ave., owner; S. Sass, 23 Park Row, N. Y. City, archt.

Rochester, N. Y.—A building permit has been granted to A. B. Headley to erect a house at Oxford St. and Park Ave., to cost $25,000; also to Anna V. and E. S. Cornwall, to erect an apartment house on Elm St., to cost $25,000.

Minot, N. D.—W. C. Smith, it is reported, is preparing to erect a $25,000 residence.

Cincinnati, O.—See "Business Buildings."

Oklahoma City, Okla. Ter.—The erection of a residence for the bishop of the R. C. Church in Oklahoma City, to cost about $25,000, is reported under consideration.

Pendleton, Ore.—The congregation of the M. E. Church, it is reported, contemplates erecting a stone edifice to cost $20,000.

**Pittsburg, Pa.*—W. E. Alberts, 375 Spahr St., it is stated, has secured the contract to erect a $50,000 apartment house at Den Cenue and Millvale Aves., for J. B. Jones.

**Wilkinsburg, Pa.*—Geo. A. Morrow, it is stated, has secured the contract to erect a $20,000 apartment house on Mifflin Ave. and Kelly St.

Philadelphia, Pa.—Plans have been completed, it is stated, by Carl P. Berger, Penn Sq. Bldg., for a stone church to be erected at Germantown Ave. and Cayuga St., for All Saints German Lutheran congregation, the cost to be about $40,000.

Tacoma, Wash.—Sizer & Ostlund, it is stated, have secured the contract for the stone work on the St. Patrick Church, to be erected at N. 12th and J. Sts., at about $16,000.

It is reported that Geo. Lewis Gower will erect a $20,000 residence at Northeast and 5th Sts.

Seattle, Wash.—The Bldg. Com. (J. E. Brown, 205 Oriental Blk., Secy.) it is stated, will receive plans and specifications until Dec. 15, for an edifice for the First Presbyterian Church, which is to be erected at 7th Ave. and Spring St. The cost not to exceed $100,000.

Milwaukee, Wis.—It is reported that Leiser & Holst, Germania Bldg., are preparing plans for a $50,000 flat to be erected at 5th Ave. and Walnut St., by John Hunholz.

SCHOOLS.

Notes Arranged Alphabetically by States.

Sacramento, Cal.—The plans of R. A. Herold, Stoll Blk., it is reported, have been accepted for the $150,000 high school.

Los Angeles, Cal.—The St. Vincent College, it is reported, will spend about $500,000 in erecting college buildings in or near Los Angeles. Rev. Jos. S. Glass, Pres.

Hartford, Conn.—Alex. Angus, Chmn. Com. Washington School Dist., writes that Max Gerstel, 756 Main St., is the architect for the school to be erected on School St., to cost about $40,000.

Gainesville, Fla.—Architects Edwards & Walter, of Columbia, S. C., write that bids will be received by the Florida Educational Board of Control, Florida State Univ., at Gainesville (N. P. Bryan, Chmn.) until Dec. 11, for the erection of the proposed dormitory buildings.

Augusta, Ga.—The Bd. of Educ. of Richmond County will receive plans for a 20-room brick school, to be erected in the 5th Ward. Address Lawton B. Evans, Secy.

Tifton, Ga.—See "Water."

Tifton, Ga.—Plans are now under consideration for the erection of a school to cost from $20,000 to $25,000.

Moscow, Idaho.—Bids will be received until Dec. 5 by Mrs. W. H. Ridenbaugh, Secy. Bd. Regents, for erecting an assay building at the Univ. of Idaho, consisting of excav., rubble stone, brick, cut stone, concrete, masonry, trusses, roofing, etc. Bid may be submitted as a whole or separately for plumbing and heating.

Cambridge, Ill.—The Bd. of School Trus, it is stated, has approved plans for a 2-story and basement school which is to be erected at a cost of $35,000

Chicago, Ill.—The faculty of the school of education of the Univ. of Chicago has approved plans, prepared by Jas. Gamble Rogers, Ashland Blk., for several new educational buildings to be erected in connection with the new university high school. A gymnasium will accommodate an indoor running track and swimming pools. The athletic field and gymnasium alone will cost $400,000. The plans provide for the installation of air-filtering, heating and ventilating plants.

Bloomington, Ind.—Bids will be received by John W. Craven, Secy. Bd. Trus., of Indiana Univ., until Jan. 4, for constructing and equipping a library building on the campus, as advertised in The Engineering Record.

Dubuque, Ia.—It is reported that plans are being prepared for 3 schools, 1 to contain 16 rooms, the other 10 and the other 8 rooms. It is stated that bids for the construction will probably be received in December.

**Fairfield, Ia.*—Bartlett & Kling, of Cedar Rapids, it is reported, have secured the contract to erect the library at Parsons College, at $16,662.

Wichita, Kan.—The Bd. of Educ., it is stated, has passed a resolution calling for a special election to be held soon to vote on the issuing of $100,000 bonds to build a high school and $30,000 to erect a ward school, and make repairs to other schools.

Sabetha, Kan.—It is stated that the citizens have voted in favor of issuing $20,000 bonds to erect a high school.

**Boston, Mass.*—Henry McGahey, of Cambridge, has secured the contract for constructing the Charlestown High School, Monument Sq., Charlestown, for $239,000 (bids opened Nov. 8). Stickney & Austin, Archts. The contract includes heating and ventilating, electrical and plumbing work.

St. Louis, Mo.—The Bd. of Educ., it is stated, has approved plans for the Lafayette School, which is to be erected on Ann Ave. and 8th St. It is to be a 2-story and basement structure and is to cost about $170,000.

**Butte, Mont.*—The contract to erect a new dormitory at St. Patrick's School, it is stated, has been awarded to M. D. O'Connell at $15,590.

Atlantic City, N. J.—It is stated that Father P. J. Petro, Rector of the Church of Our Lady Star of the Sea, intends erecting a school and a new rectory, the total cost of the building to be about $50,000.

East Orange, N. J.—The City Council, it is stated, has passed a resolution authorizing the issue of $140,000 bonds for the erection of the Ashland School on Park Ave., and the Clerk has been authorized to receive bids.

**New Brighton, S. I., N. Y.*—The following are the bids opened Nov. 20 by C. B. J. Snyder, Supt. School Bldgs., N. Y. City, for installing ventilating and heating apparatus for addition to and alterations in School 23, Boro. of Richmond: E. Rutzler Co., 178 Centre St., N. Y. City, $18,586 (awarded contract); Leonard D. Hosford, $19,974; Rossman & Bracken Co., $19,500.

The following are the bids opened same time and place for general construction, etc., of additions to and alterations in School 4, Boro. of Richmond: Philip Wolff & Son, $46,983; Geo. Hildebrand, $48,588; U. W. Osborn, $56,480; Henry Spruck & Son, $57,000, and Thos. Cummings, Jr., $54,983.

Brooklyn, N. Y.—Bids will be received until Dec. 4 by C. B. J. Snyder, Supt. School Bldgs., New York City, for general construction of School No. 8, Boro. Brooklyn.

Sanford, N. C.—It is stated that bids will be received until Dec. 20 by H. E. Bonitz, Archt., Wilmington, for erecting a 3-story school, 65x100 ft.

Coshocton, O.—The congregation of the R. C. Church, it is reported, is preparing to erect a $15,000 school. Rev. O. Syman, Pastor.

**Miamisburg, O.*—Lee Mitchell, Pres. Bd. Educ., writes that the contract for erecting a 12-room school on Central Ave. (bids opened Nov. 11) has been awarded to Unekfer & Co., of Chillicothe, for $38,816, not including ventilating and heating.

School bonds, amounting to $50,000, it is reported, have been sold.

Wilberforce, O.—Bids will be received until Dec. 21 by Dr. W. A. Galloway, Pres. Bd. Trus. of the Normal and Industrial Dept., 108 W. Main St., for installing and completing a hot water heating system and tank in tower in the Industrial Bldg. and Assembly Hall, at Wilberforce Univ. David Riebel & Sons, Archts., New First Natl. Bank Bldg., Columbus.

Chemawa, Ore.—Bids will be received by Edwin L. Chalcraft, Supt. Indian School, at Chemawa, for furnishing and delivering at the school, as required, for the fiscal year ending June 30, 1906, about 68,500 ft. lumber, 11,000 shingles, 123 doors and windows, 33,000 lath, besides a quantity of cement, brick, sand, lime, etc., about 1,025 ft. pipe, roofing, tin work, etc.

Philadelphia, Pa.—Bids were received Nov. 13 by the Property Com. of the Bd. of Educ. for the erection of a school at 62d St. and Lebanon Ave., and the lowest bid, it is reported, was submitted by W. J. Smith, at $36,500. The appropriation for this building, it is stated, is $35,000, and an additional appropriation will probably be asked.

Pittsburg, Pa.—The Central Bd. of Educ., it is reported, has secured a site on Forbes St., on which it is proposed erecting a high school.

Palestine, Tex.—The citizens on Nov. 10, it is stated, voted in favor of issuing $20,000 school bonds.

Courtland, Va.—It is stated that a $10,000 school is to be erected here.

Lynchburg, Va.—It is stated that the City School Bd. will soon ask bids for erecting a school in Rivermont, for which there is an appropriation of $25,000.

Neenah, Wis.—The City Council, it is reported, has appropriated $65,000 for the erection of a high school.

Sheboygan, Wis.—It is reported that plans have been prepared for a school to be erected in joint Dist. No. 1, and bids for the construction, it is reported, will probably received in Dec.

Ripon, Wis.—Ripon College, it is reported, has received $20,000 to erect a library.

Brandon, Man.—The School Bd., it is reported, has decided to erect a $30,000 collegiate inst., and a $9,000 school.

STREET CLEANING AND GARBAGE DISPOSAL.

Notes Arranged Alphabetically by States.

Lexington, Ky.—Mayor Thos. A. Combs writes that the city is in the market for a crematory for the disposal and destruction of garbage.

Jersey City, N. J.—Bids will be received until Nov. 27 by the Bd. Street and Water Comrs. (Geo. T. Bouton, Clk.) for sweeping, cleaning and removing all dirt, ashes, garbage, etc., from the streets of this city for the year beginning Dec. 1, 1905.

Brooklyn, N. Y.—Bids will be received until Dec. 6 (readvertisement) by John McG. Woodbury, Comr. Street Cleaning, New York City, for furnishing material and removing snow and ice by or before April 15, 1906. The two lowest bids submitted on Nov. 16 for this work was submitted by Dorlin Contr. Co., 84 B'way, Brooklyn, and the Continental Constr. & Trucking Co., 279 E. 177th St., they each bidding 16 cts. per cu. yd.

**Philadelphia, Pa.*—A. Lincoln Acker, Dir. Dept. Pub. Wks., is reported to have on Nov. 15 awarded contracts for cleaning the city streets in 1906 as follows: District No. 1 to H. A. McCleman, for $80,000; 2d, 3d and 8th Districts to E. H. Vare, at $49,999, $89,999 and $128,999 respectively; 4th Dist. to Thos. Parker & Co., $83,000; 5th Dist. to Howard E. Ruch, $102,900; 6th Dist. to John Laughlin, $50,000; 7th Dist., Jas. Curran, $75,000; 9th Dist. to David McMahon, $74,485, and 10th and 11th to David Peoples, at $60,000 and $49,890 respectively.

Ottawa, Ont.—The Bd. of Wks. is reported to be considering the question of establishing a system of garbage disposal.

NEW INDUSTRIAL PLANTS.

See also Business Buildings.

Express Glass Co., will erect a pant at Grafton, W. Va., according to local newspaper reports.

The Ewell Cooper Co., Brockton, Mass., will build a new factory, according to local newspaper reports.

Fort Wayne (Ind.) Electric Co. will build an addition to its foundry, according to local newspaper reports.

The Paducah (Ky.) Cooperage Co. will rebuild its recently burned factory, when new site has been selected.

The Tacoma (Wash.) Smelting Co. is preparing plans for a new copper wire plant, according to local newspaper reports.

The West Virginia Pulp & Paper Co. is reported to have in hand plans for an extensive addition to its plant at Luke, W. Va.

Wolf Bros. & Co., Philadelphia, Pa., envelope manufacturers, will erect a 10-story factory in that city, according to local reports.

J. H. Main & Son, Delaware, O., will build a 30x60 ft. addition to their present plant and are in the market for a 20-hp. gas engine.

Headington-Pfeil Furniture Mfg. Co., Baltimore, Md., will build a new factory, measuring 50 x 150 ft., 4 stories, 100-hp. engine and 150-hp. boiler will be installed.

Rooks-Pfeiffer Brick & Tile Co., Harrisburg, Ark., is erecting a new plant to have a capacity of 30,000 brick and 20,000 tile. Additional machinery will be required.

A. M. Ramer Co., Winona, Minn., is increasing its plant and is in the market for a freight elevator and a motor-driven pump having a capicty of 40 gal. per minute to a height of 70 ft.

The Northern Sulphite Mills of Canada, Ltd., is issuing bonds, it is reported, for the establishment at Sturgeon Falls, Ont., of a sulphite pulp plant having a capacity of 60 to 70 tons daily.

Nudd & Taylor Co., Centralia, Wash., will erect a new woodworking plant at Seattle, Wash. The new plant will consist of building, 65 x 150 ft., together with dry kilns, sheds, etc. A 125-hp. engine with 150 to 100 hp. boiler will be required.

St. Lawrence Supply Co., Ltd., Montreal, Canada, engineers and machinists, will in the spring rebuild their works which were recently destroyed by fire. The new plant will have a considerable larger capacity than the old one.

Mr. Chas. G. Emery, 143 Liberty St., New York, is contemplating building a new plant for working all polishing granite from his red granite quarries on Picton Island, St. Lawrence River. The plans for this plant have not yet been fully developed.

Chapman Iron, Coal & Coke Co., Goshen, Va., will rebuild, in the near future, its machine shop and foundry, which were recently burned. The new plant will be of the same size as the old one, 42 154 ft., and will be equipped with similar machinery and tools to those destroyed.

Bush & Terry, Philadelphia, Pa., are erecting a new carpet factory. The building will be 4 stories high and measure 48 x 80 ft. A boiler house, 18 x 30 ft. will be erected, and the company will be in the market for an engine, boiler and other machinery, as soon as details have been worked out.

Colin F. Hardy Co., Ltd., Marshall, is building an addition to its food plant, consisting of main building 50x100 ft., 3 stories and basement; oven building, 50 x 50 ft., 2 stories and basement, and power house, 50 x 50 ft., 1 story and basement, all of brick and stone construction. Power plant and additional machinery are to be purchased.

The Western Foundry Company, Chicago, is preparing to add a new foundry, cleaning building and core shop. The buildings will be of brick and steel construction and have the following dimensions: Foundry, 115 x 250 ft.; core shop, 60 x 75 ft. The melting capacity of the present plant will be increased by the addition of one cupola with a rated capacity of 15 tons an hour. The necessary machinery for the foundry and cleaning department, consisting of foundry equipment, grinding and cleaning machinery, has not yet been purchased. Bonds to the amount of $40,000 will be issued to cover the improvements.

MISCELLANEOUS.

Notes Arranged Alphabetically by States.

Colorado Springs, Colo.—Press reports state that the mine owners of Cripple Creek Dist. will raise $1,000,000 for the new drainage project, and have decided to build the deepest of the three plans submitted, known as the "Window in the Rock" scheme. It will drain the district 1,130 ft. below present tunnel and cost between $800,000 and $1,000,000.

**Washington, D. C.*—The Atlantic, Gulf & Pacific Co., of New York, N. Y., is stated to have secured the contract for dredging Potomac River, about 272,000 cu. yds. (bids opened Oct. 30) at 14.6 cts. per cu. yd.; total cost about $39,712.

Washington, D. C.—See "Power Plants, Gas and Electricity."

Chicago, Ill.—Bonds to the amount of $1,000,000 are reported sold on Nov. 13 by the Finance Committee of the Drainage Board.

***Items marked thus give the names of parties awarded contracts.**

Chicago, Ill.—Bids will be received until Dec. 2 by the Comrs. of Lincoln Park (Francis T. Simmons, Pres.) for the complete construction of a sea-going dredge.

Council Bluffs, Ia.—Bids will be received until Dec. 4 for the excavation of Indian Creek from 16th Ave. to 8th St., as advertised in The Engineering Record.

New Orleans, La.—The Bd. of Control of the New Basin Canal, has adopted resolutions providing for general improvements along the New Basin Canal. It is proposed to extend the ship basin 300 ft. further out into the lake, and make the entrance about 50 ft. wider. The canal will also be dredged at frequent intervals. The projected work will cost about $40,000. The plans for the proposed work have been prepared by the State Engr.

Jennings, La.—Press reports state that at a meeting of the Rice Irrigation & Improv. Assoc., on Nov. 15, it was voted to levy a tax on the rice lands to assist in raising a fund of $20,000, to repair the dam at the mouth of Mermentau River.

Portland, Me.—See "Paving and Roadmaking."

Grand Rapids, Mich.—The contract for the widening, deepening and straightening Indian Mill is stated to have been awarded to Jos. Rusche. He bid 50 cts. per cu. yd. on rock removal and 37 cts per cu. yd. on earth

Huntley, Mont.—See "Water."

Portsmouth, N. H.—The Boston & New York Contr. Co., 220 Devonshire St., Boston, Mass., is stated to have secured the contract for grading at Portsmouth Navy Yard (bids opened Nov. 11 by the Bureau of Yards and Docks, Washington, D. C.) for $18,939.

Paterson, N. J.—The Bd. of Aldermen on Nov. 13 authorized the City Council to draw up an ordinance providing for the issue of $200,000 bonds for dredging and deepening the bed of Passaic River. H. J. Harder, City Engr.

Atlantic City, N. J.—Bids will be received until Dec. 6 by the Bd. Chosen Freeholders, for plans, specifications and costs of installing gasoline engines with all necessary appliances for operating the draw bridges on the County Boulevard, between Atlantic City and Pleasantville. Frank Enderlin, Chmn. Bridge Com., Cologne; E. D. Richtmire, Co. Engr., Atlantic City.

New York, N. Y.—Bids will be received until Dec. 4 by Wm. McAdoo, Police Comr., for furnishing material and concreting and constructing fence wall, fence, etc., in new station house, prison and stable for the 41st Prect., Boro. Bronx.

Bids will be received until Dec. 1 by Maurice Featherson, Comr. of Docks, for furnishing and delivering about 10,000 bbls. Portland cement.

Bids will be received by Col. W. R. Livermore, Corps Engrs., U. S. A. Army Bldg., until Dec. 11, for dredging in Huntington Harbor, Canarsie Bay and Great South Bay, N. Y., as advertised in The Engineering Record.

Durhamville, N. Y.—Press reports state that after navigation closes the State Bd. of Pub. Wks., at Albany, proposes replacing the two arch aqueduct, under which the Oneida Creek flows below the canal bed at Durhamville, with a steel and concrete structure.

New York, N. Y.—See "Paving and Roadmaking."

Brooklyn, N. Y.—The following are reported to be the totals of bids opened on Nov. 15 by Martin W. Littleton, Pres. Brooklyn Boro., for furnishing material and constructing a flushing tunnel and intake and appurtenances for improving sanitary condition of Gowanus Canal: Borough Constr. Co., Brooklyn, $931,552; Jas. Malloy & Co., Brooklyn, $892,276, and John Peirce Co., 277 Bway., New York, $715,472.

Nyack, N. Y.—Bids will be received at once by the Manhattan Trap Rock Co. (W. R. Fralick, Supt.), Nyack, for dredging practically 17,000 yds. before Jan. 1, as advertised in The Engineering Record.

Pittsburg, Pa.—Bids will be received by Maj. Wm. L. Sibert, Corps Engrs., U. S. A., until Dec. 18, for building 127 Chanoine wickets for Dam No. 2 and 112 Chanoine wickets for Dam No. 3, Ohio River, as advertised in The Engineering Record.

Philadelphia, Pa.—Bids will be received by Maj. J. C. Sanford, Corps Engrs., U. S. A., until Dec. 18, for furnishing the metal work for foundation of elbow of Cross Ledge Light Station, Delaware Bay, N. J., as advertised in The Engineering Record.

Bids will be received until Dec. 1 by the Dept. Supplies (Fred. J. Shoyer, Dir.) for furnishing supplies for the Dept. Pub. Wks., in Class R, including tapping machines and fittings, taps and drills, lead melters, chain hoists, pipe-cutting machines, portable drills, lathes, jacks and pumps.

Chattanooga, Tenn.—The only bid received and opened on Nov. 20 by Maj. H. C. Newcomer, Corps, Engrs., U. S. A., for constructing the concrete river wall at Colbert Shoals, Tennessee River, Ala., was submitted by McGee & Co., of Kansas City, Mo., as follows: 8,000 cu. yds. earth excav., 50 cts.; 250 cu. yds. rock excav., $3, and 7,800 cu. yds. concrete, $8; total bid, $67,150.

Richmond, Va.—Bids will be received until Dec. 22 by Lieut. Col. R. L. Hoxie, Corps Engrs., U. S. A., for dredging, removing rock, and constructing and repairing jetties in James River, Va.

Milwaukee, Wis.—See "Sewerage and Sewage Disposal."

Seaforth, Ont.—Bids are wanted for installing an electric or telegraph fire alarm system for this town. John Rankin, Town Clk.

Olongapo, P. I.—J. G. White & Co., Inc., of New York, N. Y., are stated to have secured the contract for the coal storage and handling plant of thenaval station, Olongapo, for about $499,500. Bids for this work were opened on Aug. 26 by the Bureau of Yards and Docks, Navy Dept., Washington, D. C.

Montevideo, Uruguay.—See "Bridges."

PROPOSALS OPEN

For Proposals see pages 57, 60, 62 and 63.

WATER WORKS.

Bids Close.		See Eng. Record.
Nov. 27.	Boiler, Asbury Park, N. J Adv. Nov. 18 to 25.	Nov. 18
Nov. 29.	Water works, Davis, Ind. Ter.	Nov. 11
Nov. 29.	Mains, New York, N. Y	Nov. 18
Nov. 29.	Mains, New York, N. Y	Nov. 25
Dec. 1.	Water works, Burlington, Wash	Oct. 14
Dec. 1.	Meters, Chicago, Ill.	Oct. 21
Dec. 1.	**Water wks., Ballinger, Tex**	**Oct. 28**
Dec. 1.	Pipe, Chicago, Ill	Nov. 25
Dec. 4.	Water wks., Marksville, La	Nov. 25
Dec. 5.	**Dam, Glendive, Mont.** Adv. Sep. 16 to Oct. 21.	**Sep. 16**
Dec. 5.	Water wks., Perry, Fla Adv. Nov. 25.	Nov. 25
Dec. 6.	System, Hammond, La	Nov. 11
Dec. 6.	Intake pipe, Auburn, N. Y Adv. Nov. 18 to 25.	Nov. 18
Dec. 7.	Conduit, Salt Lake City, Utah	Nov. 25
Dec. 8.	Pipe, lead, etc., Panama Adv. Nov. 25.	Nov. 25
Dec. 11.	Water wks. improv., Nampa, Idaho	Nov. 18
Dec. 13.	Pipe, etc., Vancouver, B. C	Nov. 18
Dec. 15.	Canal work, Huntley, Mont Adv. Oct. 21 to Nov. 25.	Oct. 21
Dec. 15.	Steel water tank, Lovington, Ill	Nov. 25
Dec. 18.	Water wks., Abbeville, La	Nov. 25
Dec. 20.	Water wks., Prescott, Wash	Nov. 25
Dec. 29.	Canal, etc., Klamath Falls, Ore Adv. Nov. 4 to 25.	Nov. 4
Jan. 1.	**Irrig. work, El Campo, Tex**	**Oct. 7**
Jan. 2.	**Water wks., Manila, P. I**	**Sep. 30**
Feb. 1.	Water wks., Woodward, Okla. Ter	Nov. 25
———	Franchise, Chattanooga, Tenn. Adv. Nov. 11.	Nov. 11

SEWERAGE AND SEWAGE DISPOSAL.

Bids Close.		See Eng. Record.
Nov. 28.	Washington, D. C.	Nov. 18
Nov. 28.	Oxnard, Cal.	Nov. 18
Nov. 28.	Cincinnati, O.	Nov. 25
Nov. 28.	Akron, O.	Nov. 25
Nov. 29.	Harrisburg, Pa.	Nov. 25
Nov. 30.	**Baton Rouge, La** Adv. Oct. 28 to Nov. 18.	**Oct. 28**
Nov. —.	**Rockport, Ind.**	**Oct. 7**
Dec. 1.	Chicago, Ill.	Nov. 25
Dec. 2.	Norwood, O.	Nov. 18
Dec. 4.	Washington, Ia.	Nov. 18
Dec. 6.	Chicago, Ill.	Nov. 18
Dec. 11.	**Sheldon, Ia.**	**Oct. 14**
Dec. 11.	Nampa, Idaho.	Nov. 18
Dec. 11.	South Brooklyn, O	Nov. 25
Dec. 16.	Boston, Mass.	Nov. 25
Dec. 18.	Abbeville, La.	Nov. 25
Dec. 19.	Independence, Kan. Adv. Nov. 18.	Nov. 18
Dec. 20.	Bristol, Pa. Adv. Nov. 18 to 25.	Nov. 18
Dec. —.	Rockport, Ind.	Nov. 11
Jan. 12.	**Manila, P. I.**	**Sep. 30**
Feb. 1.	**Woodlawn, Ala**	**Oct. 28**
Feb. 1.	Libertyville, Ill.	Nov. 25
Feb. 15.	Princeton, Ind.	Nov. 25
Feb. —.	Lake Forest, Ill.	Nov. 25
Feb. —.	Highland Park, Ill.	Nov. 25

BRIDGES.

Bids Close.		See Eng. Record.
Nov. 30.	Carthage, Mo.	Nov. 25
Dec. 2.	Wichita, Kan.	Nov. 25
Dec. 4.	Gulfport, Miss.	Nov. 25
Dec. 4	Huntingdon, Ind.	Nov. 25
Dec. 6.	Atlantic City, N. J	Nov. 25
Dec. 8.	Sioux Falls, S. D	Nov. 25
Dec. 15.	Milwaukee, Wis.	Nov. 25
Jan. 1.	**Pensacola, Fla.**	**Sep. 30**

PAVING AND ROADMAKING.

Bids Close.		See Eng. Record.
Nov. 28.	Columbus, O.	Nov. 25
Nov. 30.	**Baton Rouge, La** Adv. Oct. 28 to Nov. 18	**Oct. 28**
Nov. —	**Harrison, N. J.**	**Oct. 21**
Dec. 1.	**Mattoon, Ill.**	**Oct. 21**
Dec. 1.	Cincinnati, O.	Nov. 11
Dec. 1.	Stone crush plant, Portland, Me Adv. Nov. 25.	Nov. 25
Dec. 2.	Seattle, Wash.	Nov. 25
Dec. 4.	Cincinnati, O.	Nov. 18
Dec. 4.	Union, Ind.	Nov. 18
Dec. 4.	New York, N. Y	Nov. 25
Dec. 4.	Ponce, P. R	Nov. 25
Dec. 5.	Brownstown, Ind.	Nov. 18
Dec. 6.	Paoli, Ind.	Nov. 25
Dec. 8.	Cincinnati, O.	Nov. 11
Dec. 8.	Live Oak, Fla.	Nov. 25
Dec. 12.	Cincinnati, O.	Nov. 25
Dec. 18.	Kalamazoo, Mich.	Nov. 18

POWER, GAS AND ELECTRICITY.

Bids Close.		See Eng. Record.
Nov. 27.	Brooklyn, N. Y.	Nov. 18
Nov. 27.	Jersey City, N. J	Nov. 25
Nov. 28.	**Mojave City, Ariz**	**Nov. 4**
Nov. 28.	Washingtonn, D. C.	Nov. 18
Nov. 29.	Plattsburg, N. Y.	Nov. 25
Dec. 1.	Ft. McPherson, Ga.	Nov. 25
Dec. 1.	Chicago, Ill.	Nov. 25
Dec. 2.	**San Juan, Porto Rico**	**Aug. 19**
Dec. 2.	**Ft. D. A. Russell, Wyo** Adv. Nov. 4 to 25.	**Nov. 4**
Dec. 4.	New York, N. Y.	Nov. 25
Dec. 4.	Marksville, La.	Nov. 25
Dec. 5.	Washington, D. C.	Nov. 25
Dec. 5.	Philadelphia, Pa. Adv. Nov. 25.	Nov. 25
Dec. 5.	Appleton, Minn.	Nov. 25
Dec. 7.	Sparta, Ga.	Nov. 25
Dec. 15.	Bowling Green, Mo	Nov. 25
Dec. 18.	Gas plant, Winnipeg, Man Adv. Nov. 18 to 25.	Nov. 18
Dec. 18.	Abbeville, La.	Nov. 25
Dec. 27.	**Lockport, Ill.**	**Nov. 4**
———	Franchise, Chattanooga, Tenn. Adv. Nov. 11.	Nov. 11
Apr. —.	Oakesdale, Wash.	Nov. 25

BUILDINGS.

Bids Close.		See Eng. Record.
Nov. 27.	School, Castleton, S. I., N. Y	Nov. 18
Nov. 27.	School, Hoboken, N. J	Nov. 18
Nov. 28.	**Jail cells, Kansas City, Mo**	**Oct. 28**
Nov. 28.	**Pump house, Ft. Du Pont, Del** Oct. 28 to Nov. 18.	**Oct. 28**
Nov. 28.	**Court House, Enid, Okla. Ter**	**Nov. 4**
Nov. 28.	**School, Mojave City, Ariz**	**Nov. 4**
Nov. 28.	Repairing armories, New York, N. Y.	Nov. 25
Nov. 29.	**Post bldg., West Point, N. Y** Adv. Oct. 21 to 28, Nov. 18 to 25.	**Oct. 21**
Nov. 29.	**School, Grand Junction, Colo**	**Nov. 4**
Dec. 1.	**Dwelling, Wilmington, N. C**	**Sep. 16**
Dec. 1.	School, Rossmoyne, O.	Nov. 11
Dec. 1.	Church, Champaign, Ill	Nov. 18
Dec. 1.	Bus. bldg., Muncie, Ind	Nov. 18
Dec. 1.	Pub. Bldgs., Montreal, Que	Nov. 25
Dec. 1.	Improv. hospital, New York, N. Y	Nov. 25
Dec. 1.	Theatre plans, Chattanooga, Tenn	Nov. 25
Dec. 1.	Htg. bus. bldg., Sioux Falls, S. D	Nov. 25
Dec. 1.	Hospital, Laurinsburg, N. C	Nov. 25
Dec. 2.	**Drill hall, Ft. D. A. Russell, Wyo** Adv. Nov. 4 to 25.	**Nov. 4**
Dec. 2.	**Pub. bldg., Philadelphia, Pa**	**Nov. 4**
Dec. 2.	Court house, Channing, Tex	Nov. 25
Dec. 4.	Plmbg. bldgs., National Soldiers Home, Va.	Nov. 18
Dec. 4.	School, Wallingford, Conn.	Nov. 18
Dec. 4.	School, Brooklyn, N. Y	Nov. 25
Dec. 4.	Found., for court house, Chicago, Ill.	Nov. 25
Dec. 4.	Plans for jail, Walla Walla, Wash	Nov. 25
Dec. 5.	Laundry, etc., Panama Adv. Nov. 25.	Nov. 25
Dec. 5.	Hospital, Paris, Tex	Nov. 25
Dec. 5.	School, Moscow, Idaho.	Nov. 25
Dec. 6.	Plans for bus. bldg., Stockton, Cal	Nov. 18
Dec. 6.	Pub. bldg., Baltimore, Md	Nov. 18
Dec. 6.	School, Monticello, Ind.	Nov. 18
Dec. 6.	Pub. Bldg., Cleveland, O	Nov. 25
Dec. 7.	School, Laurel, Miss	Nov. 11
Dec. 7.	School, Mt. Pleasant, Mich.	Nov. 18
Dec. 8.	Church, St. Elizabeth, Mo	Nov. 18
Dec. 8.	Bus. bldgs., Montgomery, Ala	Nov. 18
Dec. 11.	Univ. bldgs., Gainesville, Fla	Nov. 25
Dec. 12.	Court house, Fairmount, Minn	Nov. 18
Dec. 14.	School, Humboldt, Tenn	Nov. 11
Dec. 14.	Church, New Prague, Minn	Nov. 18
Dec. 15.	Pub. bldg., Ft. Meade, S. D	Nov. 25
Dec. 15.	Bank, Conway, S. C	Nov. 25
Dec. 18.	Post bldgs., Ft. Leavenworth, Kan Adv. Nov. 25.	Nov. 25
Dec. 20.	Pub. bldg., Annapolis, Md	Nov. 18
Dec. 20.	School, Sanford, N. C	Nov. 25
Dec. 21.	Htg. Univ., Wilberforce, O	Nov. 25
Dec. 22.	Hospital, Prescott, Ariz, Adv. Nov. 25.	Nov. 25
Dec. 29.	School, Marquette, Mich	Nov. 18
Dec. —	**School, Bloomington, Ind.**	**Oct. 21**
Jan. 1.	**Hotel, Davenport, Ia.**	**Sep. 30**
Jan. 1.	Jail, etc., Lillington, N. C	Nov. 25
Jan. 4.	Post Office, Natchitoches, La	Nov. 18
Jan. 4.	Library for Univ., Bloomington, Ind. Adv. Nov. 25.	Nov. 25
Jan. 8.	Court house, Hillsboro, N. D	Nov. 25
Jan. 10.	**Library plans, Toronto, Ont.**	**Sep. 23**
Jan. 10.	P. O. bldg., Reno, Nev Adv. Nov. 18 to 25.	Nov. 18
Jan. —	**Hotel annex, Louisville, Ky**	**Nov. 4**
Feb. 1.	Plans for armory, Hartford, Conn	Nov. 18
Feb. —.	Hospital, Indianapolis, Ind	Nov. 25
———	School, Chemawa, Ore.	Nov. 25
———	School Plans, Augusta, Ga.	Nov. 25

MISCELLANEOUS.

Bids Close.		See Eng. Record.
Nov. 27.	Dredging, Tarrytown, N. Y Adv. Nov. 11 to 25.	Nov. 11
Nov. 27.	Fire alarm system, Brooklyn, N. Y.,	Nov. 18
Nov. 27.	St. cleaning, Jersey City, N. J	Nov. 25
Nov. 28.	**Supplies, Washington, D. C**	**Oct. 28**
Nov. 28.	Dredging, New York, N. Y Adv. Nov. 18 to 25.	Nov. 18
Nov. 28.	Supplies, Washington, D. C	Nov. 18
Nov. 28.	Pipe system, Brooklyn, N. Y	Nov. 18
Dec. 1.	R. R. work, Richmond, Va	Nov. 18
Dec. 1.	Supplies, Philadelphia, Pa	Nov. 25
Dec. 1.	Cement, New York, N. Y	Nov. 25
Dec. 2.	**Quay wall, Key West, Fla**	**Oct. 21**
Dec. 2.	**Quay wall, Guantanamo, Cuba**	**Oct. 21**
Dec. 2.	R. R. work, Due West, S. C	Nov. 25
Dec. 2.	Dredge, Chicago, Ill.	Nov. 25
Dec. 4.	Wall, etc., New York, N. Y	Nov. 25
Dec. 4.	Ecav., Council Bluffs, Ia Adv. Nov. 25.	Nov. 25
Dec. 4.	Park work, New York, N. Y	Nov. 25
Dec. 5.	Supplies, Washington, D. C	Nov. 11
Dec. 5.	Cement, etc., Guantanamo, Cuba	Nov. 18
Dec. 5.	Ditch, Ft. Dodge, Ia	Nov. 18
Dec. 5.	Supplies, Wash, D. C	Nov. 25
Dec. 6.	Rip rap work, etc., New York, N. Y., Adv. Nov. 18 to 25.	Nov. 18
Dec. 6.	Engines, Atlantic City, N. J	Nov. 25
Dec. 6.	Remov. of snow, Brooklyn, N. Y	Nov. 25
Dec. 7.	Wharf, Ft. Moultrie, S. C Adv. Nov. 11 to 25.	Nov. 11
Dec. 9.	Electric elevator, Norfolk, Va	Nov. 11
Dec. 10.	R. R. work, Brookville, Pa	Nov. 25
Dec. 11.	Dredging, New York, N. Y Adv. Nov. 25.	Nov. 25
Dec. 12.	Dam, Wheeling, W. Va Adv. Nov. 11 to 25.	Nov. 11
Dec. 15.	**Telephone system, Billings, Mont** Adv. Nov. 4 to 25.	**Nov. 4**
Dec. 15.	**R. R. franchise, Manila, P. I**	**Nov. 4**
Dec. 18.	Wickets for dams, Pittsburg, Pa Adv. Nov. 25.	Nov. 25
Dec. 18.	Metal work, Philadelphia, Pa Adv. Nov. 25.	Nov. 25
Dec. 19.	Supplies, San Francisco, Cal	Nov. 18
Dec. 22.	Dredging, Richmond, Va	Nov. 25
Jan. 1.	**Statue plans, Indianapolis, Ind**	**Jul. 22**
Jan. 1.	R. R. work, Dubuque, Ia	Nov. 11
Jaan. 2.	R. R. work, Santiago, Chili	Nov. 25
Jan. 9.	**Wharf, etc., Auckland, N. Z** Adv. Nov. 4 to 25.	**Oct. 14**
Jan. 9.	**Jetty work, etc., Auckland, N. Z** Adv. Nov. 4 to 25.	**Nov. 4**
Apr. 2,	**'06. Harbor Work, Valparaiso, Chili,** **Adv. Apr. 29 to Sep. 9.**	**Apr. 29**
———	**Ditch work, Pomona, Ill** Adv. Oct. 28 to Nov. 18.	**Oct. 28**
———	**Fire alarm system, Seaforth, Ont** Adv. Nov. 25.	**Nov. 25**
———	**Dredging, Nyack, N. Y** Adv. Nov. 25.	**Nov. 25**

Items marked thus give the names of parties awarded contracts.